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The
Geographical Journal.

No. 1. JANUARY, 1908. Vol. XXXI.

ADMIRAL SIR LEOPOLD M'CLINTOCK, K.C.B.

By Sir CLEMENTS R. MARKHAM, K.C.B.

A great explorer, a great geographer, has passed from among us,

"his conflict past,
and life's long battle won at last."

There remains for us a great name, a name which should inspire M'Clintock's countrymen to emulate his example, and to cultivate the high qualities which made him famous.

Francis Leopold M'Clintock was born at 1, Seatown Place, Dundalk, on July 8, 1819, and was one of twelve children. He came of a Scottish family settled in county Donegal since the time of Queen Elizabeth. His father, Henry M'Clintock, formerly of the 3rd Dragoon Guards, had charge of the Custom House at Dundalk. He was a younger brother of John M'Clintock, M.P., of Drumcar, father of the first Lord Rathdonnel and of Lieut. William Bunbury M'Clintock, R.N. His wife, the mother of Leopold, was Elizabeth Melesina, daughter of the Venerable Dr. Fleury, D.D., Archdeacon of Waterford.

Leopold, when he was a very small boy, was sent to the Dundalk school under the Rev. John Darley, afterwards Bishop of Meath. His wish to go to sea was rather suddenly gratified. Captain Charles Paget was commissioning the *Samarang* at Portsmouth, and gave his nomination of a first-class volunteer to his first lieutenant, William Bunbury M'Clintock, who at once offered it to his uncle Henry for his young cousin Leopold. The letter arrived on June 20, 1831, when the little boy was not quite twelve years old, 4 feet 6 inches high, and weighing 68 lbs. He was sent off the same evening in charge of Mr. Perkins, a

tide-waiter under his father, going from Dublin to Bristol, and thence by coach to Portsmouth. The captain and every one on board were extremely kind to "little Paddy," as they called him, and Mr. Perkins took leave of him with the following injunction: "Good-bye, Master Leopold; never turn your back on the enemy while you've a face to face him with." The first lieutenant, when he went to look for his little cousin, said he was so small, it was like looking for a flea in a blanket.

The *Samarang's* commission was a very happy one. She was a 28-gun frigate. In those days the South American station included both sides. At one time she was in the Gulf of California, when Captain Paget used to take little M'Clintock on shooting excursions, sometimes for two or three days, and gave him a pea-rifle. In another part of the commission she was a good deal at Bahia and on the Brazilian coast, where the little boy learnt to swim. The *Samarang* was paid off in January, 1835, when the captain was twenty-six, having been promoted to that rank at the early age of twenty-three. He was a son of Admiral the Hon. Sir Charles Paget, K.C.B., and afterwards became M'Clintock's brother-in-law.

M'Clintock's next ship was the *Carron* steamer, employed in surveying, chiefly round the Isle of Man. It was a very rough and arduous time under an exceptionally unpleasant commander, but the *Carron* was paid off in November, 1835. M'Clintock then joined the *Hercules* (74) in the Channel squadron, under Captains Maurice Berkeley and Toup Nicholas. In 1837 he was transferred to the *Crocodile*, on the North American station, under Captain Polkinghorne. M'Clintock then saw a good deal of the ports on the Spanish main—especially Santa Marta; and after some time, the *Crocodile*, then under Captain (afterwards Sir Alexander) Milne, was sent to the coast of Newfoundland, where the young midshipman passed some time very pleasantly, shooting and fishing. He was also at Quebec. He passed for seamanship at Bermuda, and soon afterwards the *Crocodile* captured a slaver, the *Mercedita*, off the south coast of Cuba. M'Clintock was one of the prize crew to take her to Havanna, where she was condemned by the Prize Court. His share of the prize money was only £6.

In the end of 1841 M'Clintock was appointed to the *Excellent*, then commanded by Sir Thomas Hastings, to pass for a lieutenant, remaining there until 1843. He got a first class in steam machinery and practical gunnery, and a second class in mathematics.

Having completed his examination for a lieutenant, he was appointed to the *Gorgon*, a paddle-wheel steamer commanded by Captain Charles Hotham, and proceeded to the Brazilian station. At that time M'Clintock's father died, and his mother went to live in Dublin. On May 1, 1844, when at anchor off Montevideo, the *Gorgon* was driven on shore, high up on the beach, during a violent *pampero*. Commodore Purvis and others said it was impossible that she could ever float again. But

with Charlie Hotham there was no such word as "impossible." She was on the beach until October 13. Through Hotham's seamanlike skill, ably seconded by his officers and crew, she was successfully floated off. An account of this great feat in seamanship, "The Recovery of the *Gorgon*," was written by one of the junior lieutenants, the late Admiral Sir Cooper Key.

In 1845 Sir Charles Hotham presented M'Clintock with a commission as acting lieutenant, which had been placed at his disposal by Commodore Purvis. He was appointed to the *Frolic*, a sailing brig (sixteen guns), Captain Cospatrick Baillie Hamilton, and joined her, as third lieutenant, in the river Plate, when on her way to the Pacific. On October 2, 1845, the *Frolic* arrived at Honolulu and went into the inner harbour. The present writer was then a naval cadet in the flagship *Collingwood*, and to him it was a memorable date, for on that day he made M'Clintock's acquaintance, leading to a friendship which endured for sixty-two years. The *Frolic* was with us again at Mazatlan, and for more than a year she was up the Gulf of California, smuggling freight at Guaymas, while the officers were shooting deer. There were changes during the commission, and M'Clintock brought the beautiful little brig home, as first lieutenant, in June, 1847.

After some months at home with his mother in Dublin, M'Clintock went to study at the Royal Naval College at Portsmouth on half-pay. But in the early spring of 1848, his friend, Captain William Smyth, who was first lieutenant with Sir George Back in the *Terror*, recommended him to Sir James Ross, who was fitting out an Arctic expedition for the search of Sir John Franklin's ships. He was appointed second lieutenant of the *Enterprise*, M'Clure being first lieutenant. This was the turning-point of M'Clintock's life. It was his opportunity, and he seized it. Ross was an officer of quite unrivalled Arctic experience, having served in six previous expeditions, and under him M'Clintock received his training. The year 1848 was an exceptionally close year, and the expedition was obliged to winter in Port Leopold, at the north-eastern extremity of North Somerset. Sir James Ross, accompanied by M'Clintock, undertook the chief sledge journey, when, by great efforts, a distance out and home of 500 miles was accomplished in forty days. It was a period of intense labour, constant exposure, and insufficient food, and out of twelve picked men five were completely knocked up Nothing approaching to this had ever been done before. M'Clintock now knew all that Sir James Ross knew, and a great deal more. He saw, with the eye of genius, the numerous improvements which would raise Arctic sledge travelling to a great agency in the work of exploration. He spent the winter of 1849–50 experimenting on the best form of cooking-gear and of fuel, resulting in the almost perfect travelling equipment of 1851. He had the advice and assistance of Prof. Houghton.

The next expedition consisted of two sailing ships, the *Resolute*, Captain Austin, commanding the expedition, and the *Assistance*, Captain Ommanney; and the two sharp-bowed screw steamers, the *Pioneer*, Lieut. Sherard Osborn, and *Intrepid*, Lieut. Cator. The first lieutenant of the *Assistance* was M'Clintock, amongst his messmates being Lieut. Mecham, second only to M'Clintock, Dr. Donnet, Dr. Ede, Vesey Hamilton, and the present writer, the last three still living.

The year 1850, like 1848, was a close ice-encumbered year, and the expedition was obliged to winter in the pack between Cornwallis and Griffith islands. M'Clintock had already thought out many improvements on the system of Sir James Ross, especially the prolonging of the extended journeys by depôts. Captain Austin had wisely entrusted him with the preparations for sledge-travelling, and he had resolved upon autumn travelling for laying out depôts. It was the first time that anything of the kind had been attempted. In giving M'Clintock his orders on September 29, 1850, Captain Austin entered into no details, but relied upon his officer's experience, prudence, and zeal, only reminding him that the season was fast closing. M'Clintock started on October 2, established a depôt of provisions about 30 miles to the westward, and returned on the 9th.

Preparations for the winter were then commenced. M'Clintock was in his 31st year. He was short and wiry, with a lithe active body capable of great endurance. He had a turn for mechanics, and was gifted with inventive talent amounting to genius. He was a silent man, but interested in the conversations of others, and with a sense of humour. Without taking a leading part in the various amusements, he lent his active help, and occasionally contributed to our newspaper. He was an excellent messmate, and quite unrivalled as an Arctic first lieutenant. The *Assistance* was the happiest, the healthiest, the cleanest, the dryest, and the most efficient ship that ever wintered in the Arctic Regions.

Throughout the winter, and especially during March when the crews were daily exercised with their sledges, M'Clintock devoted himself to the elaboration of a great scheme of search by sledge travelling. It was due to his judicious arrangements and incessant care that the men emerged from the winter strong, healthy, and full of zeal. The construction of the sledges, tents, and cooking apparatus received the most anxious attention, as well as the clothing and scale of diet, and every article to be taken was carefully weighed and its necessity considered. The plan of search was on a larger scale than has ever been attempted before or since. There were to be as many as six extended parties going in different directions, each with its depôt party, and every three with an auxiliary party. On April 15, Captain Austin delivered a speech to the assembled sledge crews off the north-west cliff of Griffith island, and they started on their destined journeys. It was a memorable scene, the subject of a picture by W. W. May.

M'Clintock's sledge was named the "Perseverance," his motto "Persevere to the end," his flag *argent, a cross azure*. His destination was the western extreme of Melville island, which he reached on May 28. His weights at starting were 417 lbs. constant, 822 provisions, or 206 per man at starting, reduced 20 lbs. each day. M'Clintock helped the men in dragging when he was not wanted as a guide. They were devoted to him. Returning on July 4, M'Clintock and his sledge crew had been absent eighty days, and had travelled over 820 stat. miles at a mean daily rate of 10½ miles. Reporting on the sledge crew, he wrote, "I cannot conclude this account of a journey of eighty days without expressing the satisfaction the men have given me, whose labours have enabled me to fulfil my instructions. Their ever-cheerful behaviour, untiring perseverance, and patient, enduring spirit under many severe trials and privations, excited my warmest admiration." Their names deserve a place in a memoir of their well-loved chief—

James Wilkie (petty officer, 34).	James Dawson (A.B., 23).
John Salmon (A.B., 24).	Thomas Wood (R.M., 29).
James Hoyle (A.B., 25).	Robert Urquhart (R.M. 28).

Finer fellows never stepped. Their average age was 27. They all returned in perfect health. In this journey M'Clintock more than doubled his former record; and all the *Assistance* sledges fulfilled their instructions to the letter, and returned without an accident. The work of Austin's expedition was well conceived and brilliantly executed. M'Clintock was promoted to the rank of commander.

In the next search expedition two vessels, the *Resolute* and steam tender *Intrepid*, made their way to Melville island in a comparatively clear season and wintered there. M'Clintock commanded the *Intrepid*, and Mecham, who was closely following in his footsteps, was first lieutenant of the *Resolute*—Vesey Hamilton was third lieutenant, the three leaders of extended parties in 1853, with the traditions and experience of the old *Assistance*. McDougall, the historian of the *Resolute's* voyage, was also in the former expedition. On his return in 1851 M'Clintock had again devoted his time to the study of sledge-travelling problems, especially with regard to the cooking apparatus and economy of fuel. He was resolved to excel his wonderful journey of 1851, for he had brought the system to still greater perfection. In the autumn travelling of 1852 he was away laying out a depôt for forty days, and covered 225 miles. His spring journey of 1853 was the most wonderful on record. His sledge was named "Star of the North," his motto "Lead thou us on," his flag *azure, a star argent*. He discovered the northern half of Prince Patrick Land and the west coast of Melville island. His disciples, Mecham and Vesey Hamilton, discovered the southern half of Prince Patrick Land and the northern extreme of Melville island. M'Clintock was away from the ship 105 days, and

travelled over 1328 miles at a daily rate of 12½ miles. Mecham was away 94 days, and went over 1163 miles. Under exceptionally favourable circumstances in 1854, Mecham covered 1336 miles at the rate of 16 miles a day on the outward, and 20½ miles a day on the homeward journey. These journeys, without dogs, have never been approached since, and probably never will be. M'Clintock became the first of Arctic travellers, and continued to be the first and greatest until his death fifty-four years afterwards.

On his return, in the autumn of 1854, M'Clintock was promoted to the rank of post-captain. The work of the officers and men employed in the search for the Franklin Expedition is a very glorious record. It was an arduous service, but it was a labour of love, and it was illustrated and made of permanent value by the genius of M'Clintock. He wrote his "Reminiscences of Arctic Ice Travel" for the *Journal of the Dublin Society* in 1857.

At last the right direction for the search became certain through the discovery of relics in the possession of Eskimos. It was a direction which the Admiralty had overlooked. The expedition should have been sought for along the shores of King William island. When this became known, the Admiralty declined to follow up the trail—declined to ascertain the fate of the gallant officers and men they had sent to their deaths. Then it was that Lady Franklin nobly came forward, and, since the Government rejected her appeal, she resolved to spend the remains of her fortune to do the work of the Admiralty. From the first she had spent money lavishly, and had sent two expeditions in the right direction in 1850 and 1851, but they were inefficiently commanded.

This time Lady Franklin was more fortunate. M'Clintock accepted the command of her expedition. Nearly the whole cost was defrayed by her, and among the other subscribers were six relations of Franklin's officers and ten old Arctic shipmates of M'Clintock's. Lady Franklin's letter and M'Clintock's acceptance were on April 18, 1857; and he obtained leave of absence from the Admiralty. The screw-yacht *Fox* of 177 tons was purchased for £2000, and fitted out at Aberdeen, and on July 2 she passed through the Pentland firth.

The officers were Lieut. Hobson, R.N., who had served in the ice on board the *Plover*; Allen Young, a youthful master mariner, who also subscribed £500 to the expedition; and Dr. Walker, the surgeon. M'Clintock took a team of dogs this time, with Carl Petersen, the Danish Eskimo interpreter. There were twenty-one other hands, twenty-six souls all told, including two Eskimos from Greenland. Old Harvey and two others were in the Austin Expedition.

In passing up the coast of Greenland, M'Clintock was able to make a collection of the Atanekerdluk fossil flora, and thus did an important service to geology. The plant named by Prof. Heer *Macclintochia* is an entirely new genus. On entering Melville bay, it was found that

1857 was a very close ice year, and the *Fox* had the misfortune to be beset in the middle pack of Baffin's bay. She was drifted southwards all through the winter of 1857–58. The little vessel was released from the ice under circumstances of great peril. It was blowing a gale, with huge masses of ice plunging and grinding around her. But M'Clintock had no thought of seeking a port for supplies or refreshment. At once he turned her head to the north and renewed the battle. His indomitable pluck was rewarded, and he reached Beechey island in good time, in the season of 1858.

The illustrious explorer was now on the scene of his marvellous victories over nature. He proceeded down Peel sound, between North Somerset and Prince of Wales Land, but was stopped by an ice-barrier right across on August 17. Nothing daunted, he turned and proceeded down Prince Regent's inlet, very nearly succeeding in passing through Bellot strait. He wintered at Port Kennedy near the eastern entrance of the strait.

In February, 1859, he left the *Fox* to establish depôts for his spring journey. On this occasion he met some Eskimos, got some valuable information, and obtained several Franklin relics. On April 2 he again started. Passing down the channel on the east side of King William island, he again met Eskimos, who told him about the destruction of one of Franklin's ships, and bartered many relics. He then examined Montreal island, and returned after completing the circuit of King William island. He found the skeleton with its relics 9 miles south of Cape Herschel, proving that Franklin's expedition had discovered the North-West Passage. He came to the boat, with two skeletons, and made a minute inventory of its contents, as well as of the relics at Point Victory, including Graham Gore's record with the marginal additions by Captain Fitzjames, which told him the sad story. Hobson had previously visited the cairns, having been sent by another route, in order that, if anything was found, he might have the credit.

To M'Clintock is due the final revelation of the fate of Franklin and his gallant companions, so long obscured, and only made possible by the pious self-denial of Lady Franklin. M'Clintock had prepared himself for this crowning achievement during ten years of most honourable and arduous service. With the noble expedition of which Franklin was the head, and Fitzjames the moving spirit, is for ever and indissolubly connected the illustrious name of Sir Leopold M'Clintock.

The distance accomplished by M'Clintock when he discovered the fate of Franklin, from leaving the *Fox* to his return, was 1079 stat. miles, but adding all his journeys together in 1859, it was 1542 miles. His final conclusion was that one sledge party could take sixty days' food, and travel 600 miles, not more, without depôts. With Sir James Ross they only managed thirty days, in Austin's expedition forty days,

in the third expedition about fifty days. In a very long journey, his opinion was that men would beat dogs.

The engines of the *Fox* had been partly taken to pieces for the winter, and the engineer had died. M'Clintock's skill and mechanical knowledge enabled him to make them fit for work again with his own hands. Allen Young explored 380 miles of new coast-line, while that discovered by M'Clintock and Hobson amounted to 420, a total of 928 stat. miles of new coast. The *Fox* arrived in England on September 20, 1859. M'Clintock had now served during ten Arctic navigable seasons, and gone through the ordeal of six Arctic winters. He was to serve still another Arctic navigable season.

M'Clintock and his companions had an enthusiastic reception. What touched the great explorer more than anything else was the presentation to him of a gold chronometer by the officers and men of the *Fox*. "As long as I live," he wrote, "it will remind me of that perfect harmony, that mutual esteem, and goodwill which made our ship's company a happy little community, and contributed materially to the success of the expedition." On October 5, 1859, as many as twenty-five old Arctic friends entertained M'Clintock and his officers at dinner at the Thatched House, with Captain Austin in the chair. The Admiralty allowed his time in the *Fox* to count. He received the honour of knighthood; the freedom of the City of London and of the Grocers' Company; and honorary degrees of the Universities of Oxford, Cambridge, and Dublin. In 1860 he received the Gold Medal of the Royal Geographical Society, and was elected a Fellow, and in 1865 he was elected a Fellow of the Royal Society. He read his account of the work of the *Fox* at a crowded meeting of the Geographical Society on November 14, 1859.

Sir Leopold's first appointment, after his return, was to H.M.S. *Bulldog* (paddle steamer, 500 H.P., 1124 tons), sent in compliance with a request from the promoters of the North Atlantic Telegraph Route, to take a line of deep-sea soundings from the Faroe islands to Labrador. His first lieutenant was Charles Parry, a younger son of Sir Edward. Dr. Wallich was the naturalist. Leaving Stornaway on July 1, 1860, M'Clintock proceeded to Westmanshaven, in the Faroe islands, whence he ran a line of deep-sea soundings, by Reikavik in Iceland to a point 25 miles from the east coast of Greenland, a nearer approach being barred by closely packed ice. He met with heavy gales and much ice off Cape Farewell, reaching Godthaab, in Greenland, on August 7, having encountered furious gales all through the previous week. M'Clintock then ran a line of deep-sea soundings from Cape Farewell to Hamilton inlet, in Labrador, which place he reached on August 24. The greatest depth was 2032 fathoms. At Hamilton inlet he met Mr. Donald Smith, the future Lord Strathcona, and they formed a friendship which lasted through life. Recrossing to Greenland, M'Clintock made plans of Godthaab and Julianshaab. He then

took a line of deep-sea soundings from the east coast of Greenland, getting within 4 miles of the shore. But that night there was a storm from the north-east, lasting three days. The *Bulldog* had to lie to under bare poles, drifting southwards. "I could not have conceived so much calmness to have been the property of only one man," wrote Charles Parry. "In the greatest difficulties his face would not alter a muscle. Steady watchfulness and a quick, decided order, though in a low tone; no outward show of anxiety; no nervous irritability, no unnecessary noise ever betokened anxiety, though in his own quiet way, to me he has let out how deeply anxious he was on several occasions. And well he might have been! No one could have passed the same time with him, in similar situations, without gaining confidence in him week by week, until the pinnacle of confidence that man can place in man has been reached." Reikavik was reached on October 19. The line of soundings was carried on to Rockall bank on November 8, and finally the *Bulldog* put into Killibegs, on the coast of Donegal, later in November. This was an important but very arduous service, well performed.

Sir Leopold was next appointed to H.M.S. *Doris* in the Mediterranean. The present writer has very pleasant recollections of a week passed at Malta with his old messmate in April, 1861, when he was waiting for the *Doris*. He had known M'Clintock for many years, but he never before knew of his fondness and very considerable knowledge of wild flowers, or of the interest he felt in antiquities which he showed during a visit to Hagiar Chem and in subsequent interviews with old Signor Vassali at the Valetta library. The *Doris* acted as escort to the Prince of Wales (the present King) when the late Emperor and the Empress Frederick went with him on a visit to the Holy Land. Sir Leopold's next ship was H.M.S. *Aurora;* in her he witnessed the naval action between the Danish and Austrian squadrons off Heligoland, his presence preventing any possible international complication. The *Aurora* afterwards went to the West Indies, and from her Sir Leopold was transferred in September, 1865, to Jamaica as commodore, with his broad pennant on board the *Aboukir*, where he continued to serve until 1868. In that year he became a naval aide-de-camp to the Queen.

Soon after his return home M'Clintock was put forward by the Carlton Club to contest the borough of Drogheda in the Conservative interest, and though he did not succeed, he got something very much better than a seat in Parliament. One of his supporters was Mr. Dunlop of Monasterboice House, near Drogheda, who invited M'Clintock to pay him a visit. There he made the acquaintance of Mr. Dunlop's daughter.

On October 12, 1870, Sir Leopold M'Clintock was married to Annette Elizabeth, daughter of R. F. Dunlop, Esq., of Monasterboice House, and of Anna, daughter of Viscount Ferrand and of Viscountess Massereene in her own right. In the following year he came on the Council of our Society, and continued to serve, off and on, as Councillor

or Vice-President until 1903. From 1872 to 1876 he was Admiral Superintendent of Portsmouth Dockyard, and fitted out the *Alert* and *Discovery* for the Arctic Expedition of 1875–76.

Sir Leopold had completed his work, 'The Voyage of the *Fox* in the Arctic Seas,' in 1859, before he joined the *Doris*. This narrative of the discovery of the fate of Sir John Franklin and his companions, with a preface by Sir Roderick Murchison, is a perfect model of what such a book should be, and shows the character of the author in every page—his modesty, his total unconsciousness of the greatness of his achievement, his simple dignity and straightforwardness. It is a plain narrative admirably told, and is deeply interesting. It will be a classic, among the annals of British enterprise and discovery, for all time. Its value is enhanced by the appendix, containing a geological account of the Arctic archipelago, and a paper on its tidal streams by Prof. Haughton. The fourth edition appeared in 1875, and the fifth in 1881, which has been stereotyped by Mr. Murray.

Sir Leopold M'Clintock became a Vice-Admiral on August 5, 1877, and was appointed Commander-in-Chief of the West Indian and North American Station in 1879, with his flag on board H.M.S. *Northampton*. The present Admiral of the Fleet, Sir John Fisher, was his flag-captain, Admirals Holland and Fawkes were the commanders, and among the other officers was the torpedo lieutenant, an old Arctic officer of 1875–76, the present Admiral George Le C. Egerton. It was a happy and prosperous commission from 1879 to 1882.

On his return, M'Clintock was chosen an Elder Brother of the Trinity House, and at once became one of the most useful and active members of that important corporation, continuing to hold the post, so that practically he died in harness. In 1891 he was created a Knight Commander of the Bath.

Sir Leopold took a very active interest in the recent Antarctic Expedition. It was on April 7, 1899, that Sir Leopold M'Clintock and the present writer had the interview with Mr. W. E. Smith, C.B., of the Controller's Department at the Admiralty, and discussed with him the outline of what they desired as regards a ship for Antarctic work. This meeting constituted the inception of the design of the *Discovery*. A Ship Committee was afterwards formed, of which Sir Leopold was the principal and most active member. When there was opposition to the ship being allowed to winter in the Antarctic Regions, a very striking speech from Sir Leopold practically put an end to the trouble, thus ensuring the success of the expedition. He contributed a very interesting and useful paper on Arctic sledge travelling to the 'Antarctic Manual.' He felt a strong sympathy for the explorers in the south, and, anxious for the interests of Captain Scott on his return, he sent to the Admiralty a copy of the letter giving him his time in the *Fox* in 1859 as a reminder, Scott's being exactly a parallel case.

Sir Leopold took a keen interest in charitable works, chiefly on behalf of seafaring men. For many years he was a Trustee for Miss Weston. He was Chairman of the Royal Alfred Aged Merchant Seamen's Institution, and President of the Royal Naval Scripture Readers' Society.

As old age advanced, Sir Leopold faced the illnesses which accompany it with patience and fortitude. He was very happy in his family relations. A sympathetic and devoted wife was his constant companion, and he had five children—three sons and two daughters. Of his sons it can justly be said, "Truly ye come of the blood."

At last the fiftieth anniversary of the sailing of the *Fox* came round. A letter was addressed to Sir Leopold, on the part of the Council of the Royal Geographical Society, to show him how fully his great merits as an explorer, and his very distinguished services, were still remembered and appreciated. The letter was dated June 30, 1907, and was signed by the President and by two of M'Clintock's old messmates, Markham and Allen Young. In his reply the great explorer testified to the loyalty with which he was supported by those associated with him or under his command. "It is most touching," he concluded, "to find that one is still remembered after so long a time as half a century."

Sir Leopold M'Clintock caught a chill, which ended fatally, and he passed away without pain on November 17, 1907, at the age of eighty-eight. There was a great assembly of mourners on the 22nd. The King was represented by Captain Walker, R.N., the Prince of Wales by Sir C. Cust. The Deputy-Master of the Trinity House and several old colleagues were present, and the Royal Geographical Society was represented by the President and Secretary.

Many of M'Clintock's old messmates and shipmates were there to show respect and veneration for his memory.

The Austin Expedition was represented by Vesey Hamilton and Clements Markham, by the daughter of Captain Austin, the son of Captain Ommanney, and a grandson of Dr. Donnet, the surgeon of the *Assistance*. The third expedition was represented by Vesey Hamilton and George Nares; the *Fox* by Allen Young.

Of a later polar generation were present, Nares, Albert Markham, Parr, and Egerton of the 1875 expedition; Scott, of the Antarctic Expedition; and Fridtjof Nansen, second only to M'Clintock. The two grandsons of Sir John Franklin were also there, Dr. Willingham Gell and Mr. Philip L. Gell. Of Sir Leopold's old flagship *Northampton* were present, Admiral of the Fleet Sir John Fisher, and Admirals Holland, Riddel, and Egerton. A very touching memory of the *Fox* came from Copenhagen—a wreath from the directors of the Royal Greenland Company.

Sir Leopold M'Clintock was reticent, and would have disliked a long panegyric. His life-story speaks for itself, and needs none.

AN EXPLORATION OF THE NUN KUN MOUNTAIN GROUP AND ITS GLACIERS.*

By WILLIAM HUNTER WORKMAN, M.A., M.D., F.R.G.S.

The Nun Kun mountain group is situated in Suru, Kashmir, between 33° 55′ and 34° 6′ lat. N., and 76° 2′ and 76° 13′ long. E. The massif to which this name is applied is comparatively small and compact, standing by itself in the midst of a network of mountains, occupying practically a square with a side of 11 miles. Two parallel spurs of the same fold, connected with the Nun Kun by narrow ridges, extend west to 75° 53′ long. E., enclosing a glacier 8 miles long. If the mountains forming the farther barriers of the glaciers of the group be included, the area would be considerably greater.

The highest central portion is guarded on all sides by a multitude of ragged precipitous spurs or buttresses, which run down from it to the surrounding valleys, the walls of which they help to form. On the north they overhang the Suru river in the Rangdum valley, where for 8 miles, with the opposite mountains, they enclose a gorge through which it flows. The summits of these external buttresses are mostly pointed or serrated, and attain heights of 18,000 to 20,000 feet.

The central part of the massif rises 2000 to 4000 feet, not only above its own lesser peaks, but above all others for scores of miles around, the nearest peak that exceeds it in height being Nanga Parbat, 120 miles north-west. East, west, and south, none of the vast multitude of mountains which it overlooks approach it in height. It stands alone, an elevated island of rock and ice, towering bold and sharp from an ocean of surrounding peaks. Although situated in a fairly well-known region, the valleys around it having for years been visited by sportsmen and somewhat by travellers, its height and its inaccessibility have rendered its upper parts hitherto secure from intrusion.

Sportsmen have occasionally entered the Shafat nala, the easiest avenue of approach, one having camped for some days in 1905 at the site of our base camp, 4 miles above the tongue of the Shafat glacier. In 1902 the Rev. C. E. Barton and Dr. A. Neve paid it a brief visit. They camped for a night near the same point, at an altitude of 14,900 feet, and the next day went up the Shafat glacier to a height estimated by them at about 18,000 feet, returning to a lower camp the same day. In 1903, Mr. Sillem, a Dutch traveller, visited the Shafat glacier. He is reported by Dr. Neve to have reached a height on it of 21,000 feet, but what he is said to have seen is rather indefinitely stated, and does not correspond to the topographical features at that height.

The object of the expedition of Mrs. F. Bullock Workman and myself in 1906 was the more thorough exploration of this region, particularly of

* Read at the Royal Geographical Society, November 25, 1907. Map, p. 132.

the upper unvisited portions. The chief village of the several composing what is called Suru, on the Suru river, three marches south of Kargil on the Leh route, and twelve from Srinagar, was selected as our base, this being the nearest village with a lambardar to the Nun Kun. The crops having failed the two preceding seasons in Suru and Ladakh, no supplies were obtainable there, so we were obliged to forward from Srinagar not only all supplies for our party, but also some 16,000 lbs. of grain for our coolies, to transport which required 243 coolies and 60 ponies. On June 24 we reached Suru, accompanied by the guide, Cyprien Savoye, six Italian porters, and five servants.

Just south of Suru, the Suru valley, which up to this point runs south from Kargil, makes a wide bend around the extremity of a high spur, and from Purkutse, the last village where any cultivation is seen, stretches east for 23 miles, under the name of the Upper Suru or Rangdum valley. It resembles Ladakh valleys, being mostly desert with some scanty vegetation. It cannot boast of a single tree, but the swampy land along the river is covered with bush-growth from 2 to 6 feet high. For 8 miles from Purkutse it consists of a gorge just wide enough for the passage of the here turbulent Suru river, directly over which, on the south, rise the frowning spires of the Nun Kun massif, 11,500 feet above, sending down a number of short glaciers, which do not reach the valley-bed, and a larger one, the Ganri, later to be described. It then opens out with an average width of about 1 mile to its end, where it expands into an amphitheatre, into which four valleys open.

On July 3 we reached Gulmatunga, one march above Purkutse, the site of a deserted village, on the north side of the unbridged Suru river, opposite which the Shafat nala, which was our first objective, enters the Rangdum. To reach this it was necessary to cross the river, which early in July is usually fordable at this point, but we found the water so high that the only way to get over was by swimming, as impossible a feat for our loaded caravan as flying would have been. The weather during the latter half of June had been fine and unusually warm. Since leaving Dras, at elevations from 10,000 to 12,000 feet, we had marched in such sun-maxima as 191°, 199°, 203°, 196°, 200°, 206°, 204·5°, and 205° Fahr. The great heat had melted the snow on the glaciers rapidly, and we had found all glacier-fed streams on our route greatly swollen and turbid, some of them being impassable after twelve o'clock. The Suru river was no exception. Its volume was much increased, and its mud-laden water of a dark slate colour. We camped, hoping to get across early in the morning, but the water did not fall sufficiently to make the river fordable. We were therefore obliged to follow it up for 16 miles to the hamlet of Tazi Tonzas, where it divides into several branches. Here, between 8 and 10 a.m., we made the passage of five small branches, and of the 200-feet-wide main branch, though the water of the last was waist-high and flowing with a rapid current, besides being

ice-cold, so that the men had to wade through it in squads, holding on to one another for security. We then descended the valley again, through swamps and over boulder-strewn tali, till the Shafat nala was reached after four days of extra marching.

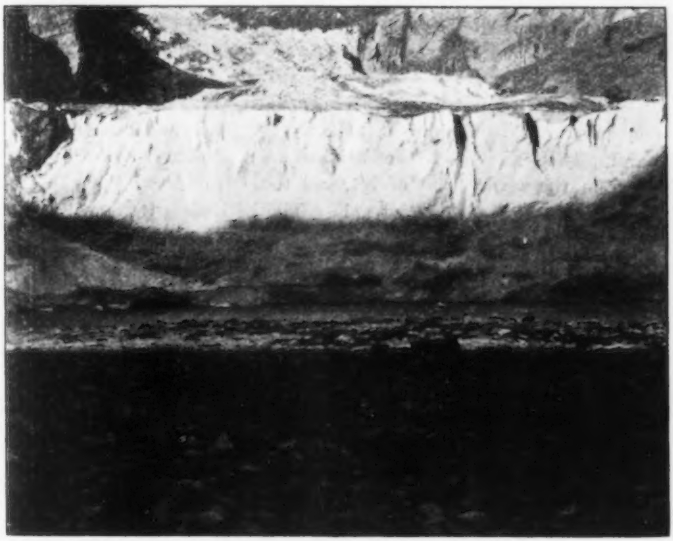
The Shafat nala runs from the Rangdum valley, a little west of south, straight away along the eastern edge of the Nun Kun for 9 miles to the base of an impressive snow mountain marked Z 1 on the Indian Survey map, seen through the nala from Gulmatunga towering above its upper end. The nala is enclosed on both sides by precipitous mountain-walls. For some distance above its mouth its bed consists of rolling hillocks, sparsely covered with vegetation. A large colony of marmots had appropriated these as a site for a subterranean city, and their burrows pierced the ground at short intervals in all directions. These marmots were evidently social in their habits, and exchanged frequent visits, as was shown by footpaths as distinct and well trodden as those made by man, running between the different burrows and forming a network over the whole surface. Were this place of sufficient importance to have a name, it might appropriately be called Marmotville. Beyond this for 2 miles the nala ascends gently in swampy meadows covered with grass and bushes resembling dwarf-willows, interspersed with stony reaches, and intersected by numerous swiftly flowing streams.

About 3 miles above the lower end of the nala the tongue of the Shafat glacier is met with, an irregular mass of ice stretching entirely across the nala, from 80 to 100 feet high, heavily covered with red granite detritus, which gives it the appearance of a large terminal moraine. The valley-bed immediately in front of it, though somewhat strewn with small stones, has no terminal moraines to indicate that, in recent times, the glacier has extended lower down than at present, to which fact the grass-covered alluvium existing almost at the edge of the tongue also testifies. Two good-sized streams issue, one on each side of the tongue, from deep gullies extending half a mile or more up the glacier. For the next 2 miles the glacier consists of a chaotic combination of high ridges, deep ravines with perpendicular walls, hillocks, and depressions, forming a labyrinth as difficult to traverse as could well be found. This part has no well-marked moraines, either lateral or median, though it is covered with an enormous amount of detritus. Its banks on both sides consist of steep mountain slopes greatly torn and eroded by ice and water.

The upper end of this portion ceases abruptly with a sharp sweep to the south-west, below which a lower surface of smooth white ice about half a mile wide begins, occupying the eastern side of the nala, and extending to the base of Z 1, 4 miles distant. This had few crevasses, but it was covered with small pockets, filled with crystal water, from a few inches to 2 feet in diameter, and from 6 inches to 2 feet deep, at the bottom of which lay either flat stones or a thin layer of silt, which, by

absorbing and transmitting the heat of the sun, had caused the ice beneath them to melt and form the pockets. Near the junction of the white ice with the lower portion were a number of glacial tables, some of them of large size, supported on ice pedestals from 3 to 6 feet high.

Adjoining the white ice on the west, but entirely distinct from it, both in character and origin, though equally a part of the glacier, runs another section parallel with and overtopping the white one by 60 to 80 feet. This section, about a quarter of a mile wide, fills the remainder of the glacial bed. It is greatly broken and crevassed, and thickly covered with reddish granite detritus. The final destination of this



SECTION OF PERPENDICULAR ICE-CLIFF, ABOUT 200 FEET HIGH, IN WHICH THE GANRI GLACIER, DESCENDING FROM THE NUN KUN, ENDS AT THE BANK OF THE SURU RIVER. PHOTO TAKEN AT 7 A.M.; LOWER PART IN SHADOW.

section affords an interesting example of the application of glacial force. On its west side, about 1 mile above the lower end of the white section, a branch glacier enters. This branch is short, not over $2\frac{1}{2}$ miles in length, and perhaps half a mile wide, but, coming down from the sides of two peaks, one of them of over 23,000 feet, with a fall of 9000 feet, it presses with tremendous force upon the Shafat glacier. As a result, the red section is crowded bodily over to the east side of the glacial bed, cutting across the white section, forming a barrier to its further progress, and literally swallowing it up. The red portion then expands so as to fill the whole glacial bed, three-quarters of a mile wide, and forms the chaotic lowest 2 miles of the glacier already described.

The very abundant detritus brought down by the branch glacier is black. This crowds with the ice of the branch into the space from which the red section has been pushed, and can be traced downward for about a mile. Opposite the point of entrance, a large hillock of black material presses well into the red section rising high above the surrounding level. The eastern edge of the white section bears along a smaller black moraine, which is also swallowed up by the red portion at their point of contact.

Opposite Z 1 the Shafat glacier, which to this point ascends with a moderate gradient south 23° W., turns around the end of a spur from the Nun Kun, and pursues a course west 10° S. to a ridge 3 miles above, descending from the central one of the row of five southern Nun Kun peaks across the slope to meet an arête projecting from Z 1. This ridge rises only slightly above the glacial surface, but it forms a line of demarcation, on the north side, between the snows, which, coming from three of the Nun Kun peaks, feed the Shafat glacier, and those from the remaining two which fall to the Fariabad nala; and on the south, between those from the whole front of Z 1, and those from it west of the arête, which also fall to the Fariabad nala. The altitude of this ridge at a quarter of a mile from the wall of Z 1 is 16,911 feet. Thence it rises continuously till it ends in a peak of over 21,000 feet.

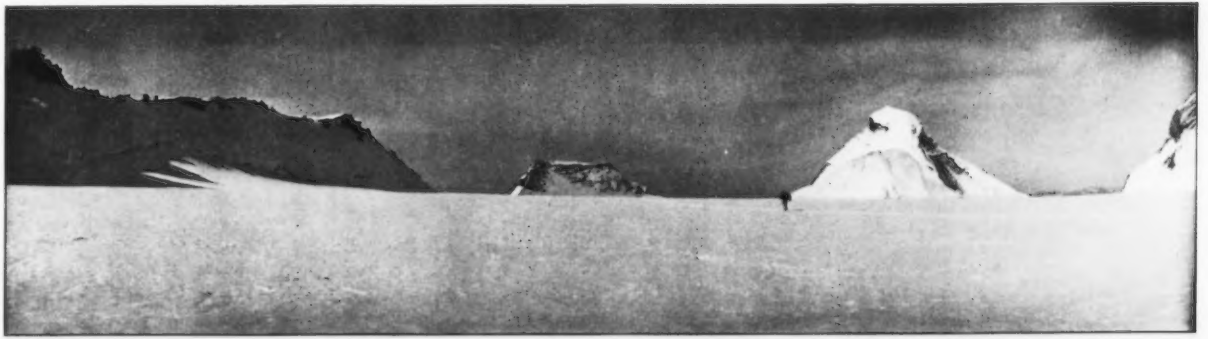
The reservoir of the Shafat glacier differs from those of the ordinary type, in that it is composed of two lateral parts or wings, over 2 miles distant from each other, the northern wing consisting of the slopes of the Nun Kun massif, and the southern of those of Z 1, the snows from both of which descend east of the boundary ridge into the intermediate depression, meeting near its middle line to form the glacier. The glacier is therefore destitute of a typical head or end basin enclosed by mountains on the west.

Its width just above the bend is about a mile, but below the ridge it widens to more than 2 miles, ascending sharply and greatly broken to the Nun Kun. The ice from the south or Z 1 wing is remarkably free from detritus, but that from the Nun Kun wing bears a considerable quantity in detached masses, which finally becomes concentrated in the red western section already described.

The glacier coming from the two remaining southern Nun Kun peaks, named by us the Fariabad glacier, descends from north to south across the upper end of and at right angles to the Shafat, contributing to the latter a small amount of ice through an opening in the dividing ridge near its centre.

We established a base camp on the spur around which the glacier turns, about 400 feet above the latter at an altitude of 15,100 feet. It commanded a view of a second tributary entering the Shafat from the east in an impressive ice-fall, and of the steep front of the splendid peak Z 1, over 22,000 feet in height, clad in a shaggy mail of ice, portions of

Upper three miles of Shafat glacier descending from Nun Kun peaks on north (right) and Z 1 on south (left). The glacier is open on west, terminating at rock ridge on sky-line passing from Nun Kun to Z 1.



South-west half of Nun Kun basin, as seen from its centre, showing highest peak, 23,447 feet, and three outlets. Right hand outlet forms one head of Gauri glacier, the other two feed the Fariabad glacier. We entered basin at point directly behind figure on surface. What appears to be a slope of highest peak is White Needle Peak directly in front of it.

which every now and again broke away and plunged down to the glacier in resounding avalanches. After the Nun Kun massif Z 1 is the highest and most imposing mountain in the region.

While wood and supplies were being collected at this camp, we made reconnaissances of the ice-fall opposite, ascending the lower half of it, and of the higher parts of the Shafat glacier on both sides to heights of about 18,000 feet, from which an excellent idea of the glacier and its basin was obtained; but from no point could we see the conformation of the highest portion of the Nun Kun massif lying behind the five southern peaks crowning the wall above, nor could the relation of the

HILLOCK COMPOSED OF DETRITUS FORCED UP BY PRESSURE OF BRANCH GLACIER UPON SHAFAT GLACIER AT LINE OF CONTACT. BRANCH HAS A FALL OF SOME 9000 FEET. FIGURE OF SERVANT NEAR CENTRE OF HILLOCK GIVES IDEA OF SIZE OF LATTER.

highest western peak to its neighbours be determined, nor were the two northern peaks next in altitude to the highest visible, except the very apex of the north-easterly one from the ice-fall under Z 1.

Large portions of the *névé*-covered surface of the Shafat glacier, from 16,000 to 18,500 feet, were thickly strewn with *nieves penitentes*. This was the first time we had met with them in five seasons of Himalayan exploration, and I am not aware that their existence in Himalaya has been mentioned by any other observer. For a time they were regarded as peculiar to the Andes, having been observed only by explorers of that chain, until Hans Meyer, and after him C. Uhlig, discovered

them on Kilimandjaro. In the Andes they have been found from the equator to 35° 4′ lat. S., while those seen by us existed from 33° 57′ to 33° 59′ lat. N.

They varied in height from 8 inches to 3 feet, and had the shape of wedges or pyramids flattened at the sides with curling fluted crests, all turned in the same direction.

They were arranged in parallel lines running diagonally to the axis of the glacier, the long diameter of each nieve being parallel to the long diameters of others in the system and coincident with the direction of the lines. They were composed of granular snow, hard frozen in the morning, but softening more or less under the heat of the sun. No ice was found in them. The central portion of each, even when softened by the sun, was much denser than the outer surface or the surrounding *névé*, offering even in the smallest decided resistance to the thrust of an ice-axe, while the two latter could often be scraped away with the fingers. The *névé* on which they stood sloped at angles of 30° to 40°.

As this was the only one of many Himalayan glaciers we have explored presenting this phenomenon, attention was directed to the conditions obtaining on it as furnishing a clue to the mode of formation of the nieves. As already stated, this glacier is peculiar in that it is acephalous, being entirely open at its upper western end and fully exposed to the prevailing west winds, which sweep down its course with considerable force even in fair weather, and during storms must attain a high velocity. Another important condition not seen by us on other glaciers was the long-continued fine weather. During our Baltistan expeditions fine weather was the exception, almost daily snow-storms being the rule; but here, from early in June till our departure on August 9, the weather was continuously pleasant, only one slight squall being noted. In ascending the glacier, and on the mountains above, even to over 21,000 feet, no new snow was met with. To these two conditions the formation of the *nieves penitentes* here seen may be referred.

It is a matter of common observation that, when any object lies upon a glacier which protects the snow or ice beneath it from the sun's heat, or a condition exists that offers resistance to the same, the surrounding surface melts away, leaving an elevation of snow or ice in such place. When a rock rests on a glacier, a glacial table supported on an ice pedestal may result. Ice pyramids are sometimes seen capped with mud or fine detritus. When a portion of a glacial surface becomes more dense than that around it, the softer portions melt away, leaving the denser one standing as an upward projection.

This premised, the development of these nieves may be read as follows. During the winter and spring storms the wind, sweeping down the glacier, drifted the loose snow into waves and ridges. These, particularly the latter, were formed parallel to one another, with a direction more or less transverse to the axis of the glacier. The force of

the wind packed the snow composing the ridges, so that it became much denser than that in the hollows between them. Wind is the only natural force conceivable that could have caused ridges and wavy condensations of snow in the positions occupied by the nieves, upon fairly smooth slopes not exposed to avalanches and above the line of rain. This action of the wind being granted, it follows that the formation of waves and ridges of condensed snow was the first step in the process of development.

Then came the prolonged period of fine weather, when no new snow fell to cover the roughened glacial surface, when the latter was exposed

NIEVES PENITENTES ON SHAFAT GLACIER.

during the long days of June and July to the full action of the sun, burning with a heat of 170° to 206° Fahr. and over. As melting proceeded, the softer snow of the hollows yielded to a greater degree than the harder snow of the ridges, thus accentuating the difference of level between the two, and the ridges themselves were sculptured out, the densest and most resistant parts remaining as apices, till, finally, the flattened pyramids known as *nieves penitentes* were fully formed.

The fact that the discrete pyramids, many of them with the ends of their elongated bases touching the similar ends of adjacent ones, stood in lines parallel to other lines, indicates (1) that they were formed out of pre-existing ridges or linear wavelets, and (2) that the condensation of snow in the ridges was not equally great at all points, but occurred in

foci, the crests of which were a little distance apart, each crest, as melting proceeded, forming the apex of a nieve.

The glacier falls from west to east, east 10° N., and the line of union of its north and south slopes corresponds with its axis. The direction of the longer diameters of the nieves and of the lines of which they formed a part, was, on the north slopes, east 20° S., whilst that of those on the south slopes was north 45° E. The former cut the glacial axis at an angle of 30°, and the latter at one of 35°. The linear rows of nieves on the two slopes were thus inclined to one another at an angle of 65°. From this it appears that the direction of the primary ridges was determined by the direction of the slopes on which they were formed, the wind remaining constant to both. The apices of the nieves on both slopes curved over more or less, giving the pyramids a convex contour on one face and a concave one on the opposite. These, as well as the overhanging hoods, with which many of them were crowned, all pointed in the same direction, *i.e.* towards the east, down the glacier, away from the prevailing west wind, which never varied during the three weeks we were on this glacier. Both the curving apices and the hoods were probably due to the cornices formed by the wind along the crests of the primary ridges, which being denser offered greater resistance to the sun's heat than the snow immediately under them, and persisted as overhanging parts of the nieve. It may be noted that nieves were found only above the line where freezing occurs at night, *i.e.* above 16,000 feet, which circumstance may be a contributory factor to their development or modelling.

From the foregoing, the conclusion may be drawn that the formation of *nieves penitentes*, certainly of such as were here seen, depends on two conditions: (1) the existence of a strong wind blowing constantly from the same direction, driving the snow into wavelets and ridges usually parallel to one another, and condensing it into compact masses at foci a little removed from one another; and (2) a prolonged period of fine weather following, during which the softer portions are melted away by the sun's heat both direct and reflected, leaving the denser parts standing in the well-known shapes. In stormy seasons the ridges, after being formed, would be protected from the sun's action by new snow under which they would be buried, and no nieves would be developed.

Six miles west of the upper end of the Shafat glacier stands a hitherto unnamed summit of 19,080 feet, called by us Mount Nieves Penitentes, and 2 miles north of it another of 20,571 feet, D 41. First ascents of both of these were made by us. The last 300 feet in altitude of the rounded top of the former as well as others of its upper surfaces were thickly covered with *nieves penitentes* of the same character as but larger than those on the Shafat glacier. Above 19,000 feet the final slants of D 41 rise at angles of 60° to 70°. These, facing south, but fully exposed to the west wind, bristled in every part quite to the summit, with

nieves rising one above another in unbroken succession. These were the largest of all, rose from an ice basis, and themselves consisted of ice. In connection with the statement of Prof. Hauthal, that *nieves penitentes* in the Andes occur exclusively in sheltered places, it is interesting to note that those observed by us at three different points in Himalaya occurred on surfaces fully exposed to wind, that the higher and more exposed the surface the larger were the nieves, and that the largest, most perfectly developed, and apparently the most durable of all, were found at the highest altitude, from 19,000 to 20,571 feet, where the wind would naturally be the strongest. On the Barmal glacier, springing from the

SUMMIT OF MOUNT NIEVES PENITENTES, 19,080 FEET, COVERED WITH NIEVES PENITENTES. D 41 IN BACKGROUND, 2 MILES TO NORTH.

two last-mentioned peaks and a wall connecting them and protected by precipitous mountains, and in the Nun Kun basin at an altitude of 21,000 feet, covered with snow and also much enclosed, no nieves were seen. Sir Martin Conway, from his observations of *nieves penitentes* on Aconcagua (see 'Aconcagua and Terra del Fuego'), concludes they are carved by solar radiation out of old avalanche beds, wind having nothing to do with their origin. Nieves formed in this manner would be found only on circumscribed areas in positions, which avalanche beds might occupy, and not widely distributed over glacial surfaces and on mountain-sides and tops, as in case of those seen by us, where there could be no question of avalanche beds. The conditions under which nieves have been observed have evidently differed somewhat in different places.

Prof. Hauthal also regards the sun as the sole agent in the formation of nieves. This hypothesis fails to explain satisfactorily the parallelism of the lines in which the nieves stand, as well as the implied selective power of the sun in melting away some portions of a glacial surface and leaving others intact, both of which can be accounted for by the known action of wind in causing parallel wavelets and ridges and condensing the snow in them.

Gussfeldt, one of the early observers of Andean nieves, is one of the few who recognize the agency of wind in the first stage of their development, but he does not mention the causation by it of foci of condensation that offer resistance to the sun's heat, which I regard as an essential factor in the process.

While the conclusions above stated appear to me to be the only ones consistent with existing conditions that will explain the formation of the nieves observed by me, I am quite willing to grant that condensation of snow in foci may, in certain cases, be caused by other agents than wind.*

The experience of four previous expeditions having demonstrated that coolies cannot be depended on to go much above points where rocks exist for shelter at night and water is to be had, the plan was adopted, with a view to exploring the higher parts of the Nun Kun, of taking out trained European porters to carry light camp outfit to altitudes above those which can be reached by coolies. Six porters besides the guide, who also agreed to carry a load when necessary, were judged sufficient for our purpose, and this number had accordingly been brought with us.

A reconnaissance disclosed a rock promontory projecting into the ice about 2500 feet above our base camp, with screes beneath it, where coolies could pass the night; and about 2200 feet above that, among the icefalls at the base of a snow-needle, a small sloping snow-plateau, which the coolies, by starting early from their night bivouac, could reach in time to return to the latter the same day. This was the highest point at which they would be available. Basing our plan of attack on the upper portion of the massif on the existence of these two *pieds à terre*, a good supply of wood and food was forwarded to the promontory, and two days later four porters with coolies were sent ahead with their own and our extra outfit, with orders to remain over night at the promontory, move up next morning with the coolies to the plateau, and make a second camp there, sending the coolies back to us. From here they were to push on and establish a third camp with extra Mummery tents at the highest available point, and then return to and await us at the second camp.

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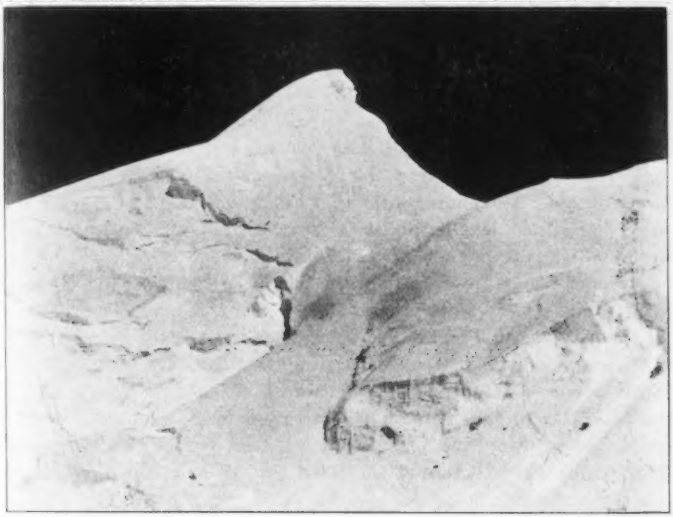
* For some further details, see *Zeitschrift für Gletscherkunde*, Band ii. Heft i., July, 1907, p. 22.

On July 25, Mrs. Bullock Workman, myself, Savoye, and two porters, with fifteen coolies, followed, climbing at first over great moraine masses, and later over tumbled and crevassed slopes of ice and snow lying between the giant rock-ribs descending from the peaks above. We saw many *nieves penitentes*, some of them of large size. We camped on snow just above the base of the promontory at an elevation of 17,657 feet. The minimum night temperature was 17° Fahr. The next morning we continued on up still wilder ice-slopes, steep and fatiguing, greatly broken, and seamed with wide blue chasms lined with icicles, to the second camp, where the four porters were waiting. This camp stood at



WHITE NEEDLE PEAK, ONE OF THE ENCLOSING BARRIERS OF THE NUN KUN BASIN; ALTITUDE ABOUT 21,800 FEET. NOTE PROFILE ON RIGHT OF APEX. THREE BLACK DOTS IN CENTRE ARE PORTERS DESCENDING SLOPE.

19,900 feet on a small sloping surface at the base of a ragged wall, from which at intervals great icicles were broken away by the wind and hurled down in dangerous proximity to the tents. Two hundred feet distant below the camp a wide bergschrund yawned. The coolies marched well to this point, though some of them were sick at the last, and nearly all complained of headache. They were allowed to return to the lower camp on arrival. The minimum temperature here was also 17° Fahr. On our return it was 10° Fahr. The wind blew down upon us in strong gusts the whole night, shaking the tents so that we feared we should be carried down into the bergschrund. This, with the altitude, the effect of which all felt decidedly, effectually prevented sleep.

From here the whole party of nine started upward together. The only possible route led up the steep face of the ice-wall, and above it involved the traverse of a long, sharply inclined, curving ice-slope covered with snow. Had the passage of our caravan started an avalanche, as we feared might occur, we should have been carried down over the wall into an abyss of unknown depth running along its whole base. Two weeks later, when the snow had melted or become converted into ice, this slope would have been too dangerous to attempt. Its top lies at an altitude of about 21,000 feet, at the base of a beautiful snow-needle some 800 feet higher, which crowns the extremity of a short arête projecting from the highest Nun Kun peak. Up to this point we had seen nothing of the massif except the slopes facing the Shafat glacier. On reaching the crest we found we were standing, not on a col between the first and second of a line of peaks, as the Survey map and previous statements had led us to expect, but just above the brow of a glacier emerging from a great oblong snow-plateau or basin, about 3 by 1½ miles, enclosed by six great and one smaller peak, the highest of which, 23,447 feet, rises up by itself steeply from the plateau unconnected by cols with any of the others. Descending into this basin, we reached the third snow camp, which had been established at an altitude of 20,632 feet. The minimum temperature here was 4° Fahr.

Reconnaissance from this and the preceding camp showed the ascent of the highest peak to be impracticable from this plateau, certainly for our party, as it could be assailed only at one point, above which it would be necessary to camp, the arêtes leading to which are so steep that no loaded porter could probably surmount them, and, if passable at all, would tax the powers of an unloaded expert to the utmost. We therefore moved the camp the next morning 3 miles farther to the upper end of the plateau, at the base of the peak next in height, which promised better conditions. Here our fourth snow camp was pitched at an altitude of 21,300 feet. The porters could only bring half the necessary kit at one time, so they and the guide descended to the third camp for the rest, intending to return that afternoon. But a dense mist after midday and the softening of the snow by the great heat prevented their return, so that Mrs. Bullock Workman and myself were left to pass the night alone in the almost terrifying silence and loneliness of this untrodden solitude of snow.

We did not sleep. As I have found before under similar circumstances, the absolute silence that reigned during the watches of the night, in the absence of sleep, proved almost as nerve-wearing as an excess of noise. In such a situation one has the feeling of having completely lost touch with the material world, and the imagination, uncontrolled by the suggestions of ordinary sounds, runs riot among fancies and possibilities neither wholly pleasing nor reassuring.

The afternoon was windless and oppressively hot. The sun shone

through the drifting mist with a sickly light, but with a heat that sent the mercury in the solar thermometer up to 193° Fahr. at 2 o'clock, and to 142° Fahr. at 3.30 o'clock. The heat was equally unbearable within and without the tents, and all the harder to endure because of the mist, which, while shutting out all view of the world around, shut in the heat, so that it became a palpable entity penetrating to every part of the system with depressing effect. At sunset the temperature fell to freezing, and an hour later to 10° Fahr., reaching a minimum of −4° before morning, a difference of 197°.

At daylight, Savoye and two porters arrived, their faces blue with

SECOND SNOW-CAMP (WHITE NEEDLE CAMP) AT 19,900 FEET (AIRY, 20,251 FEET), AT BASE OF ICE-WALL BENEATH WHITE NEEDLE PEAK. ROCK PEAK, ONE OF SOUTHERN ENCLOSING PEAKS OF NUN KUN BASIN, IS 1½ MILE EAST OF THE CAMP.

cold and their moustaches covered with ice. Having drawn on our frozen boots, we set out with them to ascend the steep ice-covered flank of the mountain above, its lower half broken into ice-falls, where almost every step had to be cut. At an altitude of 22,720 feet, as the mists which almost daily obscured the mountain-tops towards noon were gathering, I stopped with one porter to photograph, while the latter were yet visible, and Mrs. Bullock Workman went on with the other two to complete the ascent, attaining an altitude of 23,300 feet. Camp was reached at 7 p.m. The temperature fell that night to −6° Fahr.

I have stated the altitude of our highest camp as 21,300 feet. This

was measured by hypsometric readings compared with simultaneous ones at the lower Government station of Dras, 34 miles distant, where readings were taken for us three times daily during our absence. The same readings, calculated by Airy's table, make its altitude 21,600 feet. The variation being so great, and Airy's table differing from others in placing sea-level at 31 inches and giving relatively higher altitudes for very low pressures, the results of calculations by it have not been used. If Airy's table can claim greater accuracy than the older tables, then the altitude in question must be regarded as 21,600 feet. In either case this camp is of importance practically, as I hope presently to show, as representing, I believe, the highest point to which, up to date, November, 1907, tents have been taken and occupied, and the highest measured point at which mountaineers have passed the night. Two parties have recently claimed to have bivouacked in the open without tents at greater altitudes, Mr. Reginald Rankin on his descent from Aconcagua being overtaken by darkness at an elevation he states as 22,000 feet, and Dr. Longstaff, with guide and porter, under similar circumstances, having spent a night in the snow at what he "thinks" was 23,000 feet. From their published accounts it appears that in neither case was the altitude mentioned determined by any kind of measurement.

It has been asserted several times within the past year that Mr. W. H. Johnson, in the employ of the Indian Survey, camped in 1865 in the Kiún Lún at an altitude of 22,000 feet. I have been unable to find, in Mr. Johnson's account of his work in the 'Synoptical,' Vol. 7, of the Indian Survey, and in the *Journal* of the Royal Geographical Society, any mention of such a camp. If any camp, which Mr. Johnson thought approached this altitude, was made, it must have been on the peak E 61, the only peak in the region exceeding 22,000 feet, which was measured in 1862 by a Survey employé and its height given as 23,890 feet. This measurement was unchecked, and the details of it were so meagre that the Survey did not endorse it, expressly stating that, for reasons given, they considered it too high—as I have been credibly informed, probably 1000 feet or more too high. Any camp, therefore, that Mr. Johnson may have made on this mountain, the altitude of which he would naturally estimate with reference to the assigned height of the mountain itself, would have to be lowered by the same amount, which would bring it in any case below the altitude of our recent highest camps.

In order to place mountaineering on a scientific basis, among other things, the necessity of the measurement of altitudes reached, by one of the methods recognized as fairly reliable, is obvious, since such measurement alone defines with approximate exactness the height at which observed altitude phenomena may occur, and without it observations lose an important part of their value. In this connection I would call your attention to some of the subjective experiences, particularly at

night, of the nine Europeans engaged on this occasion, not merely in high climbing, but in carrying loads, making and occupying camps measured at 19,900, 20,632, and 21,300 feet (by Airy's table 20,251, 21,093, and 21,600 feet).

Only one of the party—a porter—suffered from mountain sickness. Although complaining of headache and weakness at the third camp (20,632 feet), he started to go to the fourth with a light load of instruments, but was unable to keep up with the rest of us and soon fell behind, showing unmistakable signs of mountain sickness. Before

THIRD SNOW-CAMP (CAMP ITALIA) AT 20,632 FEET (AIRY, 21,093 FEET) NEAR SOUTH-WEST END OF NUN KUN BASIN, EXTENDING NORTH-EAST OF CAMP TO TWO OTHER ENCIRCLING PEAKS 3 MILES DISTANT. ONE AT LEFT IS PINNACLE PEAK, 23,300 FEET, ASCENDED JULY 29, 1907.

reaching an altitude of 21,000 feet, though naturally a strong and healthy man, he collapsed entirely and became helpless. He complained of loss of sensation in his hands. His woollen mittens being drawn off, his fingers were found white and stiff, and, if not already frostbitten, on the point of becoming so. Vigorous rubbing and pounding of his hands finally restored circulation, when he was sent down to the third camp. The fact that his hands, even when protected by thick woollen mittens, were brought by the cold to the verge of frostbite, while my own, without any covering, were comfortably warm, shows how profoundly the circulation and vitality are prostrated by mountain sickness, and how

dangerous it is for one suffering from this malady to be exposed to the cold of high altitudes.

At the second camp, 19,900 feet, and above, three suffered with severe headache, pain in back and lower limbs, especially at night, and a fourth with headache at night; while three were troubled with cough without discoverable pharyngitis or bronchitis, which promptly disappeared in two cases on descending to the base camp, but persisted for a week in the third. These symptoms did not incapacitate any one, except the porter who was ill, from accomplishing the daily work.

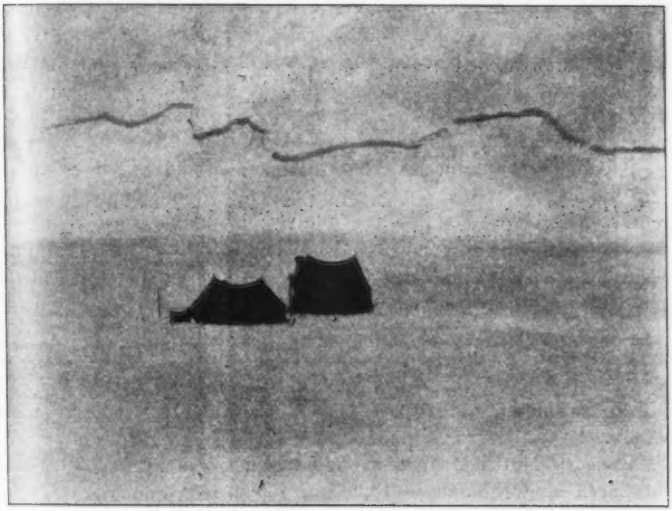
Every one, as was to be expected, felt the effect of altitude on the respiration, though some to a greater extent than others. This, as usual, manifested itself by shortness of breath and panting on slight exertion. In the erect position, when resting, the respiratory disturbance was not so noticeable, being marked only on movement, but at night on lying down it became more urgent, being accompanied by a feeling of oppression, for the relief of which a number of deep inspirations were necessary. The frequent repetition of these wearied the respiratory muscles and even became painful. This constant gasping for breath interfered with sleep, no matter how tired one might be, and if, at last, after a long period of prostrating wakefulness, one did doze for a moment, one would immediately start up with frantic efforts to obtain sufficient oxygen to relieve the stifling sensation which threatened to terminate one's existence. During the five nights at our three highest camps no one obtained more than a few snatches of sleep, and four, of whom I was one, practically none at all. Those nights are not easily forgotten, when one lay sleepless on the snow, in the cold, and silence, and darkness, struggling for breath, and counting the slowly dragging hours with a feeling that the strain could not be endured till daylight. It is scarcely necessary to say that even the strongest could not hold out for long against the depressing influence of loss of sleep, combined with the lowering of vital energy due to the scarcity of oxygen at these high altitudes. We were conscious of a distinct decline in strength on the last two days, and after six consecutive days of hard work and five sleepless nights every one felt an irresistible desire to relieve the tension by a descent to a lower level.

I have elsewhere, in connection with our highest camp in the Chogo Lungma region, at 19,358 feet, where five Europeans were affected in a similar manner during two nights, suggested the possibility that, in attempts on the highest Himalayan summits, where camps would have to be made at from 23,000 to over 27,000 feet, insomnia alone might prevent success.* This corroborative experience of nine active mountaineers at camps approximately 550, 1300, and 2000 feet higher than that above mentioned, at all of which respiratory disturbance and

* See *The Alpine Journal*, August, 1905, p. 14.

insomnia were distinctly more pronounced, being most marked at the highest, appears to me now to justify the opinion that insomnia will be found to be an adverse factor in high mountain work no less formidable than cold, deficiency of oxygen, and weather, and much more so than mountain sickness, inasmuch as it appears likely to affect a larger number of climbers.

Our primus stoves and hypsometer lamps felt the altitude quite as much as we. The alcohol in the lighting cups of the former would not burn until the cups had been heated by the application of half a dozen burning matches, and the petroleum gas issuing from the burners was



FOURTH SNOW-CAMP (CAMP AMERICA) AT 21,300 FEET (AIRY, 21,600 FEET) AT BASE OF PINNACLE PEAK. ITS DESOLATE SITUATION IS APPARENT.

only partially consumed when saucepans were placed at the ordinary distance above the latter, the rest escaping in smoky ill-smelling fumes. To insure complete combustion it was necessary to give the flame its full height, so that the air could have access to it from every point. With this precaution petroleum in a primus stove makes a more efficient fuel and generates a much greater heat at high altitudes than alcohol used in any apparatus I have seen. The wicks of the hypsometer lamps were also lighted with difficulty, two or three matches in succession being required, and when they were lighted, placing the lamps in the metal jackets promptly extinguished the flame. Having had the same experience previously, we had had the burning-tubes replaced by new ones of double the diameter, but this did not help the matter. The ordinary

jacket does not admit sufficient oxygen to insure combustion at high altitudes. The lower half of the jacket, at least, should be made of wire-gauze so as to admit all the air possible.

We found the low temperature, $-4°$ and $-6°$ Fahr., and even that of 17° and 10° Fahr. with strong wind, trying, at night. Arctic explorers endure temperatures much lower than these without difficulty, but their work lies near sea-level, where the atmospheric pressure is more than double that at 21,000 feet, and they can encase themselves in furs without suffering from the weight. There the air also contains sufficient oxygen to enable them to breathe freely under any degree of exertion, and to sleep soundly, thus sustaining the bodily heat and vital forces at a normal limit, so that they can offer a maximum power of resistance to cold. But at high altitudes, where vitality has been lowered by hard work, loss of sleep, and deficient oxygenation, where only a closely calculated minimum of clothing and bedding can be carried, an amount really insufficient to protect one against cold, a temperature of zero means a good deal more than it does to the Arctic explorer. The mountaineer at high altitudes is called upon to endure Arctic conditions without the means of protection available to the Arctic explorer. All our party, in addition to flannel-lined Mummery tents, with ground-sheets sewn in, were provided with rubber ground-sheets and well-padded eider sleeping-sacks, enclosed in outer ones of camel-hair or army blankets; but these were inadequate to prevent us, even when wearing our thickest clothing besides, from feeling the cold sensibly at night at the second camp, and to a much greater degree at the two highest camps. Two thousand feet higher, where the cold would be considerably greater, we should probably have suffered more severely.

An effect of altitude upon the mind, which was noticeable here, as it has been elsewhere above 18,000 or 19,000 feet, deserves mention. Owing, perhaps, to a general loss of energy and to the disturbance of respiration and circulation incident to even moderate exertion, a mental condition of irresolution and disinclination to effort supervenes. The simplest actions assume formidable proportions, and even photography, which one recognizes as of the highest importance and which at ordinary altitudes is not a difficult process, becomes a bugbear; while the ascent of a peak, a really arduous undertaking at high altitudes, looms up as an almost impossible proposition. One has, therefore, often to call the will into play to its utmost power to force one's self to carry out what has been proposed. Those who are destined to raise the mountaineering altitude record much higher than it now stands will undoubtedly be persons of strong will and self-control.

Another point of interest is, that the guide and porters were able to carry loads of 40 lbs. to an altitude of 21,300 feet. The gradients, except that of the ice-wall above the second camp, were not steep, and the last

two marches upward were only about three hours; but to carry loads of 40 lbs. up inclines of 25° to 35° in snow ankle-deep, at that altitude, requires strength and endurance. How much higher they could have gone, or up how much sharper slopes, I will not venture an opinion. Savoye expressed grave doubts whether they could carry the same loads up much steeper gradients than were encountered, for at altitudes like these the difficulty of carrying a given load increases enormously with a comparatively slight increase in gradient. These men were certainly more efficient than coolies, and with their aid we were able to make two camps at altitudes which could not have been reached with coolies.

Peak D 42.

VIEW DOWN BARMAL GLACIER FROM POINT ABOUT 20,000 FEET HIGH ON D 41. SLOPE IN FOREGROUND COVERED WITH NIEVES PENITENTES.

The question to what height trained mountaineers will be able to carry outfit requisite to camping must be left to the future to decide. With the various obstacles to high climbing more accentuated in proportion to altitude, it seems certain that loads will have to be reduced as altitude increases, until a limit will at last be reached where not enough can be carried to support life and protect the mountaineer against cold and weather. That limit is likely, I fancy, to be found considerably below heights at which camps will have to be made to render the highest summits accessible.

One of the most interesting features of the Nun Kun is the plateau, or snow-basin, where we camped, which, enclosed by its circlet of seven

glittering peaks, sits like a diadem on the brow of the lofty massif which it crowns. Its surface is undulating, being depressed in the centre, but rising towards the bases of the peaks, where it shades off into the mountain slopes. The altitude of its highest part, which is at the north-east end beneath the second highest peak, is 21,600 feet. Thence it slopes away to the south-west to about 20,300 feet at the Ganri outlet under the highest peak. Its shape is oblong, its long diameter running north-east and south-west being 3 to 3½ miles, and its conjugate diameter about 1½ mile. The peaks rise sharply from it, and descend more sharply, largely in perpendicular precipices, on the outer side. The four north-east peaks are connected by rock and snow saddles. The other three, including the highest at the south-west end, stand alone, rising directly from level ice. Around the bases of these three the basin has four outlets, by which its snows escape to form the ultimate source of the three principal glaciers of the massif, one stream descending north-west between the highest peak and the one next north-east to make one head of the Ganri glacier, two others to the south to feed the short but broad Fariabad glacier, and the fourth also to the south, to contribute to the north reservoir of the Shafat glacier. It is very unusual for three glaciers to originate in a single basin.

The Ganri glacier has two reservoirs, or heads, the larger one drawing its snows from the whole north-west side of the highest Nun Kun peak, from the north slope of an arête running from the latter to the Barmal ridge (an arête of D 41), and from the north-east face of D 41, which unite in a converging snow-field 3 miles wide at its upper part, with a fall from about 19,000 to 17,000 feet. The second head descends from the Nun Kun basin, leaving the latter at an altitude of about 20,300 feet. The two come together at the end of a rock arête of the highest Nun Kun, just above the entrance to a gorge enclosed on both sides by ragged mountains descending steeply to the Rangdum valley. The upper end of the gorge appears to be at an altitude of about 17,000 feet. From this point the glacier, crowding into the gorge in a greatly narrowed stream, tumbles more than 5000 feet in a continuous line of seracs to near its termination 8 miles below its sources.

The most remarkable feature of this glacier, and one seldom seen in purely mountain glaciers, is its tongue, which ends abruptly at the river-bank, like that of a polar glacier extending to tide-water, in a perpendicular ice-precipice about 600 feet long and 200 high. Its successive layers, as they separate themselves, fall in miniature icebergs into the current, by which they are carried away and strewn along the river-banks below. The river washes the base of the whole front of the tongue, apparently cutting under its lower edge somewhat; but the depth to which it can undermine the ice must be slight, as the latter does not project appreciably into the river, but breaks off at the edge of the bank. Here a river not many feet in depth is seen to produce

the same effect upon a massive glacial tongue as is produced by the deeper waters of the polar oceans upon glacial tongues that push into them.

West of the tongue, and separated from it by a considerable interval, a giant lateral moraine, over 200 feet high, and towering above it by more than 100 feet, extends entirely across the valley, and similarly a shorter lateral moraine projects on its east side. These moraines, together with the boulder-masses piled up in the space between them, show that the glacier was formerly much longer, wider, and thicker than at present, covering the whole width of the valley and impinging against the opposite mountain walls. The amount of detritus brought down to build these moraines and boulder-masses was enormous. At present the glacier, as seen both from above and below, appears remarkably clean and free from detritus.

The third or Fariabad glacier, beginning in the two southern outlets above mentioned of the basin, and reinforced by snows from the external slopes of the two western peaks, descends rapidly in a confused mass of ice-falls, caverns, crevasses, and seracs, directly south to the side of the Z 1 glacier above the opening of the Fariabad nala. It is separated from the Shafat glacier on the east by the ridge before mentioned, and is bounded on the west by a large spur from the highest Nun Kun, descending to the Fariabad opening. Its length is 4 and its width 2 miles. It is a most dangerous glacier to venture on.

The three principal Nun Kun glaciers are not very long, being respectively only 9, 8, and 4 miles in length, but, springing from heights of from 22,000 to over 23,000 feet, and falling 10,000 to 11,000 feet in these short distances, they possess great potential energy, developing ice-falls, ice-precipices, and seracs as large and high, crevasses and abysses as wide and profound, ridges and ravines as pronounced, and moraines as gigantic, as those found on glaciers of far greater size and length.

We decided next to try to complete the circuit of the Nun Kun. Reconnaissance showed that no passage to the west from the top of the Shafat glacier at a high level existed, the way being barred by the spur descending from the highest Nun Kun to the Fariabad opening, followed by a succession of arêtes, snow-basins, and precipices; but if we could get down over the Fariabad glacier, or over a sharp rock-spur of Z 1, to the Fariabad opening lying 4000 feet directly below, we might find a way by a nala that was seen to ascend north-west from the last, and to end in a great amphitheatre of ice and snow, at the top of which a saddle might be found. This would be a matter of pure pioneering, as the survey map was of no assistance,* and *none* of our coolies knew

* Those who are at all acquainted with the history of the Indian Survey know that its work in the northern part of Kashmir territory was, and under the circumstances had to be, more in the nature of a reconnaissance than of a finished survey, salient points being fixed and intermediate details, which could not be seen, being

anything of the proposed route. Success was by no means certain, but we determined to try it.

We accordingly cut loose from our base camp on August 9, with fifty coolies carrying a minimum of lightest outfit and nine days' supplies, sending all other luggage back to Suru in charge of a Gurkha and shikari by way of the Rangdum valley. We ascended the Shafat glacier, crossed the ridge above it, and descended the east edge of the Fariabad glacier till it plunged down so steeply and became so broken that it was no longer available. We then crossed to the rock-spur of Z 1 at an altitude of about 16,000 feet, and descended with considerable difficulty its precipitous greatly broken face, covered with loose rocks and *débris* for some 2000 feet to the Z 1 glacier, which, falling from the top of the mountain in a very steep ice-fall, fills the Z 1 nala almost to its junction with the Fariabad nala. A short distance above the tongue of this glacier the tongue of the Fariabad glacier, coming down from the Nun Kun in a great broken ice-wall, ends abruptly at its edge without any terminal moraine. The tongue of the Z 1 glacier ends in a steeply falling front of discoloured ice, 300 feet or more in height, with a sharply defined curving contour thickly seamed with longitudinal crevasses. Here, also, there is no terminal moraine, though the nala-bed below is sprinkled quite thickly with *débris*.

Glaciers do not by any means always form terminal moraines. As to this fact, there is no difference of opinion among glaciologists, in whatever manner they may account for the formation of such moraines. The one hypothesis, that terminal moraines result from the gathering up and pushing along of the subglacial ground-moraine material, and even, as some hold, of the ploughing up of the terrain beneath the ground-moraine by an advancing tongue, and to a less extent by a stationary one, so as to form a wall at its end, fails to account for the cases where no terminal moraine results, even under the most favourable conditions of active advance. It also ignores or minimizes the part which moraine material carried by the tongue must play in the process of moraine building. It is evident that no moraine would be formed by a tongue in retreat.

The other hypothesis, that such moraines are wholly due to the deposition and excretion of the material lying in and upon the tongue, presupposes the co-operation of two factors: (1) that a glacial tongue should carry a considerable quantity of detritus, and (2) that its front should remain stationary long enough for the detritus to be deposited in sufficient quantity to form a moraine, *i.e.* the ice from above must advance to the terminal line as fast as the ice there melts and discharges its detritus upon that already deposited, till the process is completed. By this

filled in on the resulting map by inference. It is, therefore, no discourtesy towards the Survey for those exploring the hitherto unvisited intermediate parts to mention the absence or inaccuracy of topographical details on the map.

hypothesis, if a tongue carries no moraine material, no moraine should be formed under any conditions of advance or retreat. This fails, in its turn, to account for those cases where glacial tongues bearing no observable moraine-material have been found to be bounded by high and large terminal moraines. If the end of a tongue recedes faster than the ice above it advances, no moraine results, its detritus being spread more or less evenly over the denuded surface without accumulating at any one point.

The tongues of the two glaciers above mentioned, at present, furnish examples of the absence of one of these factors in each case. The Fariabad tongue bears no detritus to speak of, and has no deposit at its end. That of Z 1 has been receding constantly and rather rapidly for some time, and, though carrying considerable *débris*, has left it evenly distributed over the nala-bed in front of it, not having paused long enough at any one point to build an elevation that might be called a moraine. Half a mile farther down the nala are some larger *débris*-deposits overgrown with vegetation, which might be regarded as terminal moraines.

The successive terminal moraines often found in front of glaciers, with intervals between them little or not all strewn with detritus, show that the same glacier, according to the presence of both these factors or to the absence of one or both, may build terminal moraines at one time and fail to do so at another. The smoothness of many such intervals would indicate that, during a period of recession, the respective tongue carried but little detritus. In Himalaya, glaciers may recede for considerable distances without leaving behind *débris* of any size, as in case of the Chogo Lungma tongue, cited in a paper read by myself before this Society (see *Geog. Journal*, March, 1905, p. 251), which has retreated 1184 feet in forty-two years, leaving a smooth river-bed below it. Observed facts appear to show that there is truth in both the above hypotheses, and it is not improbable that many moraines are formed by the combined action of both the methods they suggest. In 1902 and 1903, when I saw the tongue of the Tippur glacier, near that of the Chogo Lungma, it was adding to its large terminal moraine at a rapid rate by the deposit upon the latter of detritus from its upper surface.

From the Fariabad opening we followed up the nala leading north-west (North-West Nala). About a mile above the former, west of the rock-spur from the highest Nun Kun, a glacier from the base of that peak reaches the north side of the nala in an ice-fall, but does not penetrate it. Two miles above this, a glacier, descending from the mountains on the south, fills the nala for another mile. Two hundred feet in front of its tongue is a high terminal moraine composed entirely of fine brown sand with ice still beneath it. This appears as if it might have been formed by the ploughing up of the nala-bed by the glacial tongue during an advance. The sand has protected the ice on which

it rests from the sun's heat, while the uncovered ice behind it has melted entirely away. Higher up another glacial tongue enters the nala from the south, on which are two picturesque lakes. After ascending the steep glacial amphitheatre in which the nala ends, we came to a snow col at 17,347 feet, south of Nieves Penitentes peak, and east of the head of the Bara Zaj Nai nala, to which most dangerous-looking ice-slopes descend. We named this North-West col.

The only practicable passage from here appeared to be towards Mount Nieves Penitentes. A gentle descent of half an hour brought us to its base. Here we were overtaken by a dense mist. Having fortunately taken bearings before it set in, we pushed up an ascending snow-slope in the mist between an ice-fall and a bergschrund, and finally reached a rock-arête rising above the snow close under the western angle of Mount Nieves Penitentes at an altitude of 17,260 feet. This our coolies, who arrived two hours later, and who up to this point could give us no information, recognized and called the Barmal la. Here we camped four nights. The Barmal la commands a view of the head and of much of the course of the Barmal glacier, a large and handsome sheet of ice springing from the slopes of Nieves Penitentes peak and of D 41, 2 miles north, and from a high rock-wall connecting them, which we named the Barmal ridge. It runs westward for 8 miles, walled in on each side by a line of jagged peaks, and ends among green slopes south-east of a mountain-cirque enclosing the reservoir of a branch of the Bhot Kol glacier. The width of the Barmal glacier near its origin is about 2 miles, but it soon narrows to 1 mile, maintaining this width for over 5 miles. This glacier is not on the Survey map. It has, however, evidently been long known to the natives, who often cross it with yaks in going between Tongul and the Bara Zaj Nai, and also the Fariabad nala. Local tradition credits one European with having visited it many years ago. In 1902, Rev. C. E. Barton and Dr. A. Neve, ascending from Tongul, crossed it to the Bara Zaj Nai nala at a point about 5 miles west of the highest Nun Kun. In 1904, Dr. Neve reports having crossed it again at the same point, and having climbed on the side of D 41 to a height stated as 19,200 feet.

On two successive days we made first ascents of Mount Nieves Penitentes, 19,080 feet, and D 41, 20,571 feet, from the summits of which we obtained not only comprehensive views of the surrounding region, but unobstructed views of the western end of the Nun Kun massif, of the two reservoirs of the Ganri glacier, and to the west the full sweep of the Barmal glacier to its end 8 miles beyond.

In the February 1903 *Alpine Journal*, Dr. Neve shows a photograph of a section of the Barmal glacier taken from the pass to the Bara Zaj Nai, which he designates as "the Great Western Glacier of Nun Kun." He further states in his 'Tourist's Guide to Kashmir,' 6th edit., 1905, p. 122, that Mr. Barton and he, in 1902, "discovered" that the Bhot Kol

Panorama from summit of Mt. Neve Penteutes, 19,680 feet. Peak on left is D 41, 20,571 feet. Barnal Ridge runs from it to lower edge of picture in centre. These two enclose northern half of head of Barnal glacier. Peak on right is highest Nun Kun, the snows around which are turned by the ridge running from it to centre of Barnal Ridge, and by latter into the Ganri glacier on north and, as seen in foreground, into the north-west nala on south. Peak at extreme right is Z 1.

Panorama from summit of D 41, 20,571 feet, showing two heads of Ganri glacier, the larger in foreground coming from highest Nun Kun, the Barnal Ridge and D 41, the smaller descending from Nun Kun basin between highest peak and one next north of it (on left). Arete from highest peak to Barnal Ridge concealed by cloud. Part of west face of Barnal Ridge at extreme right.

glacier comes all the way from the Nun Kun peak." Also in the February 1905 *Alpine Journal*, p. 350, he speaks of the Barmal glacier as "the upper Bhot Kol glacier." From these quotations it is evident that he supposes the Barmal to be identical with the Bhot Kol glacier, and that its ultimate source is the highest Nun Kun peak.

I cannot agree with him in either of these suppositions. As regards the first, it may be said, having been over the same ground, and having also traversed the Bhot Kol glacier from end to end, I found no evidence that the two glaciers are identical. The lower end of the Barmal glacier, where Dr. Neve supposes the connection to be, is separated from the Bhot Kol by mountains and ridges from 17,000 to 19,000 feet in height. As regards the second supposition, from the summits of Mount Nieves Penitentes and D 41, the south-west and north-west faces of the great pyramid of the highest Nun Kun are seen to be separated by a sharp rock-arête, broken at one place, running down the pyramid from its apex to its base on the high plateau, where the arête is lowest. Thence it passes directly west, rising as it goes, and joins the Barmal ridge at its highest central point, about 19,000 feet.

This arête and the Barmal ridge turn all the snows coming from the Nun Kun peak, and those of the plateau between this and the Barmal ridge, into the west reservoir of the Ganri glacier on the north, and towards the North-West nala on the south side, and, as can be seen from these photographs, not a particle of snow from the Nun Kun can enter the Barmal glacier. Had Dr. Neve climbed sufficiently high on D 41 to fully overlook the Barmal ridge, he would have seen the impossibility of this supposition.

The ascent of Mount Nieves Penitentes and of D 41 was by no means easy. Both are peaks of the very first order. One slope of the former, requiring three-quarters of an hour to climb, was steeper than could be measured by the scale of Abney's level, being apparently 70° or 72°. The last 1500 feet of D 41 was also difficult, consisting of ice-slants varying from 60° to 70°. Fortunately these were wholly covered, as stated, with *nieves penitentes*, forming a precipitous giant stairway of ice, by which we were able to scale it in safety. Had its surface been smooth, the undertaking would have been much more difficult, more fatiguing, and highly dangerous. Half an hour after the top was reached a thick mist swept up from the Barmal glacier and enveloped us, shutting out all landmarks. This was accompanied by an icy wind, which congealed the breath into icicles on our moustaches and covered our clothing with feathery fringes. Recognizing the danger both of remaining and of descending, we preferred to attempt the latter, and succeeded in getting down in two parties invisible to each other, by following the slight spoor made in ascending. Previous to departure a stone cairn was built on the summit and notes of the ascent placed in it.

The Barmal la stands perhaps 600 feet above the Barmal glacier, at the top of a very steep ice-wall cleft by two bergschrunds, to ascend or descend which requires a good knowledge of ice-craft. Our coolies were powerless to negotiate it alone, which fact prevented many of them from deserting during the four days we camped there, and even the guide and porters would not venture on it unroped. Two rock-cairns stand on the summit of the la. By whom they were made we could not learn. No records were found in them, and I know of no account of any European having visited this place. As it is practically certain that natives could not reach it from the Barmal glacier unless the ice-wall were greatly changed, it may be surmised that some party, having come up to it from the south side, mistaking it for a snow-pass somewhat farther west, and having found the descent to the Barmal glacier barred by the ice-wall, built these cairns as a beacon by which the place might in future be avoided. The existence of other cairns on ledges to the south, indicating the way to the other pass, supports this view. Half or three-quarters of a mile west lies the snow-pass referred to, accessible by easy snow-slopes, leading from the Barmal glacier to the Bara Zaj Nai. It is over this pass that the natives take their yak-caravans from Tongul, and this was the pass used by Dr. Neve, also under the name of the Barmal la.

The Sentik la is a depression about a mile distant from D 41, in the ridge leading west from it. Over this pass lies the way from the Barmal glacier to Tongul, the nearest village in the Suru valley. Below the pass the Sentik glacier, about 3 miles long, coming from the north side of D 41 and neighbouring mountains, and receiving two ice-falls from the west reservoir of the Ganri glacier, descends north to the head of a very steep nala, enclosed on both sides by jagged rock-peaks, below which slopes and ridges fall away to Tongul, a short march from Suru. By this route we returned to the latter village, having covered over 90 miles of rough country in completing the first circuit of the Nun Kun, besides many more in exploration and ascents.

August 18 and 19 were very warm days at Suru, the sun burning with unusual fervour. We had found during the summer, as during those of 1902 and 1903, sun maxima of 200° to 206° Fahr. at high altitudes to be not at all uncommon, but had never known them to attain the figures reached on these days. On the 18th, at 1 p.m., the sun thermometer registered 206°, and, at 1.15, 212° Fahr. As this last figure seemed incredible, the instrument, which was so hot that it could scarcely be touched by the hand, was raised to the vertical position and shaken, but the mercury did not fall. At 1.25 it reached 216°. This was not only an unusually high maximum, but it occurred at an unusually late hour, most maxima I have observed occurring at or before 1 o'clock.

On the 19th, at 12.30 p.m., the thermometer registered 196°. At

12.45, 213°. At 1, through a thin film of cloud, 217°, not falling when placed vertical, and at 1.5, 219° Fahr. The altitude of Suru is 10,850 feet. As sun-temperatures increase in proportion to altitude, what must the temperatures on these days have been at over 20,000 feet?" * On these, as on other occasions when I have noted high temperatures, the maxima showed themselves in sudden waves or flashes of heat lasting a few moments and then subsiding. It may also be noted that, as on the 18th, some of the highest temperatures have occurred when the sky was covered with thin cirrho-stratus clouds.

Before the paper, the PRESIDENT: The lecturer of the evening, Dr. Hunter Workman, is going to address us on his last expedition with Mrs. Bullock Workman, his wife, in the Himalayas. I regret that Mrs. Workman has not been able to be here to-night, as we hoped she would have been, because she is engaged in something almost more arduous than climbing 23,000 feet. She is delivering thirty lectures in thirty-seven days, starting from Munich and going by Vienna up to Dresden, Berlin, Hamburg. I need not introduce Dr. Workman to you, because he and Mrs. Workman are old friends of our Society. It is about eight or nine years since they started on their explorations in the Himalayas. Dr. Workman delivered an address here about three years ago on his journey from Srinagar to the sources of the Chogo Lungma glacier. They then returned to the Himalayas, and in the following year Mrs. Bullock Workman gave us a very interesting address on the earliest exploration ever made of the Hoh Lumba and Sosbon glaciers. To-night, after fresh travels and always on new ground, we are to hear from Dr. Workman an account of their joint ascents in the Nun Kun group. I shall not enter into the difficult question as to what traveller has ascended the greatest height above sea-level. We have Dr. Longstaff here, and I believe there is only a matter of about 10 feet between them, him and Dr. and Mrs. Workman; but I will remind you that all of these explorers are not merely trying how high they can climb. Careful observations are taken of glaciation and in other scientific directions, so that their ascents have real scientific value.

After the paper, Sir THOMAS HOLDICH: I am rather glad of this opportunity of expressing my admiration for the consistency and the determination and the ability with which a long record of observations has been taken by Dr. Hunter Workman and his gallant wife—if he will allow me the expression—under circumstances of extreme difficulty. I have had some slight acquaintance with the difficulties and the disabilities which beset the taking of observations in very high altitudes in the Himalayas, and I can only liken it to the conditions under which a man might find himself if he was at sea in very stormy weather, and very sea sick, and was asked suddenly to make records of the height of the waves and the strength of the winds: he would find that it took a great deal of resolution and determination to effect his purpose. It is indeed a most difficult proposition.

There are some of the phenomena to which Dr. Hunter Workman has referred which I had the opportunity of observing, to a certain extent, when I was in the Andes. He referred to the *nieves penitentes*. Now, although I saw nothing of *nieves penitentes* in the highest altitudes of the Andes, yet I did observe distinctly the same results, induced probably by the same causes, on the surface of the wide plains which intervene between the Andes and the Atlantic, as I was crossing in winter;

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* See the *Geographical Journal*, March, 1905, p. 260.

and I was convinced that the cause of the formation which Dr. Hunter Workman puts forward is correct, namely wind-action. I know of no part of the world in which the wind is more persistent from a certain quarter than it is on the western slopes of the Andes and across the intervening plains between the Andes and the Atlantic. The *nieves penitentes* of the Pampas were most obviously caused by wind. As regards his criticism of the Survey maps, I have very little to say. I can only explain to you, as he must be very well aware, that it is not, and never can be, one of the primary objects of the Survey Department of India to make detailed maps of regions so inaccessible and so remote as those which Dr. Hunter Workman has visited. All I can certainly promise is that the department which is responsible for those maps will receive with the greatest thankfulness any corrections or recommendations that explorers of the type of Dr. Hunter Workman, who take observations carefully and consistently, may possibly give to them.

You must know, for it has been frequently discussed in this hall, the difficulty that exists in determining altitudes at such great heights as those with which Dr. Hunter Workman has been dealing. Barometric observations are notoriously uncertain, and amongst them we must include hypsometric observations, that is, observations obtained by the boiling-point of water, to which Dr. Workman has referred; all are equally affected by variations in atmospheric conditions. There is no doubt that the most certain way of determining the heights of remote and inaccessible peaks is by a process of triangulation, where the angles are actually measured and heights reduced by mathematical processes. But all the same, it must be admitted—and will be admitted by any mathematician—that even so there are uncertainties when it comes to dealing with such enormous altitudes as those of the Himalayan peaks. We do not know exactly, and at present there is no means of determining, what the exact effect of refraction may be in those altitudes; and the result of variation when applied as correction to those observed trigonometrical altitudes may be very considerable. For instance, I may mention that we are still in doubt as to the exact height of the highest mountain in the world, Mount Everest. But we are pretty certain that whatever the correction may be that has to be eventually applied when we are more certain than we are at present of the value of refraction, it will not diminish that height. On the contrary, Mount Everest will probably prove to be some hundred feet or so higher than we at present reckon it. But when we come to the mountains which approach Mount Everest nearest in height, K_2, which is situated in the north-west of the Himalayas, and that grand peak Kinchinjunga, opposite Darjiling, we are not at present sure which is the highest. We know which is the highest peak in the world, but we do not know the second highest. It may prove—personally, I think it will so prove—that K_2 (a peak with which Dr. Hunter Workman is well acquainted), which has always been considered to be the second highest, will prove to be third, and Kinchinjunga will have the honour of ranking second.

However that may be, we must all of us accord our unmitigated admiration to the exploits of a lady who has succeeded in exploring such inaccessible altitudes as Mrs. Bullock Workman has done. My admiration for her achievements is unlimited, and I think that, even if it is impossible to say, amongst some four or five people who have ascended higher than any people in the world, which individual amongst them has actually achieved the proud position of getting highest, still we must agree that amongst those few Mrs. Bullock Workman certainly takes a prominent place. Under which circumstances, it is possible that it may be suggested to you, as it has been to me, that it is almost time that a great society like this ranked ladies and men together on precisely the same plane of geographical research. I won't pursue that subject any further; but if any

movement hereafter should ever take place which would allow ladies as Associates of the Royal Geographical Society to receive the same official recognition as men receive, all I can say is that such a movement would have no warmer supporter than myself.

Dr. T. G. Longstaff: I congratulate Dr. and Mrs. Workman very heartily on the great feat they have performed. I should think that Mrs. Workman's record for altitude will never be beaten by any other lady but herself, and any one who knows what climbing at high altitudes means must appreciate the extraordinary degree of fortitude and perseverance with which she is gifted. This ascent of a peak of 23,300 feet by a lady must always rank as one of the most wonderful mountaineering exploits on record. Dr. Workman deserves the thanks of all of us for his self-sacrifice in devoting himself to photography, the results of which have given us such pleasure this evening, instead of completing the ascent, although, of course, he climbed higher than the summit of this peak in 1903.

I must also congratulate my friend Cyprien Savoye and the six Courmayeur porters on the successful accomplishment of a very arduous enterprise. One of the essentials for still higher ascents will be that the man—or lady—who makes the final climb must not be tired out by several days of load-carrying just beforehand; and this plan of having a good supply of the very best professional Alpine porters will no doubt be necessary. In my opinion, not even the Gurkha, with all his pluck, has quite the same stamina for this sort of work as the Alpine peasant, though I, for one, prefer his company.

Dr. Workman has mentioned my name in connection with the greatest altitude at which travellers have encamped, but is not correct in what he has said about me, as he will see if he reads the account of my Tibetan experiences in 1905 in the *Alpine Journal* (vol. **23**, pp. 202–228). If he had read my account, he must have noticed my reference to W. H. Johnson. This gentleman, who belonged to the staff of the G.T.S. of India, and was also a Fellow of this Society, spent a night at over 22,000 feet in the Kuen Lun when surveying beyond the Changchenmo in 1864 (*J.R.G.S.*, **37**, pp. 1–47; and *Proc. R.G.S.*, **11**, pp. 6–14). But the question of records does not in any way detract from the wonderful feat of endurance performed by Dr. Workman and his wife in spending a night at well over 21,000 feet, after they had already spent three consecutive nights at great altitudes.

Though Dr. Workman does not exaggerate the unpleasant symptoms experienced by most people at high altitudes—indeed, he rather makes light of them—I cannot agree with him as to the improbability of the ascent of the highest mountains on the globe, provided always that a relatively easy route exists which is not barred by "questions of high imperial policy." On the Tibetan side of Everest the snow-line probably lies above rather than below 19,000 feet. The rest must be climbed in two days, and this cannot at present be said to be an impossible performance, because both Graham's party and my own, on the final day of the ascent of the two highest mountains that have yet been climbed, were able to ascend nearly 6000 feet and get back to camp for the night. Although I believe that personally I could not climb as high as the summit of Everest, I am equally sure that there are others who can. I wish I was as sure that Englishmen will be permitted to make the attempt.

Dr. Workman's observations on the existence and formation of *nieve penitentes* and on the relative absence of terminal moraines in this part of the Himalaya, are most interesting and valuable. But in reference to the latter, it seems to me that the action of streams and landslips combine to modify such structures in the Himalaya to a much greater extent than in the Alps or Caucacus, and I have

several times been puzzled to know whether I was standing on a terminal moraine or not.

The mountaineering obstacles to the success of Dr. and Mrs. Workman's expedition have been great; the extreme steepness of the snow-slopes we have seen on the screen to-night must have frequently subjected them to serious risks from avalanches. I think that the difficulties, and indeed the actual hardships, that are involved in taking photographs and observations at high altitudes, are realized by very few, either of the general public or scientific geographers, and I again congratulate them most heartily on what they have done, and I hope that they will be thoroughly successful in the expedition which I hear they are undertaking next year, and that Mrs. Workman will raise her own record still higher.

Dr. HUNTER WORKMAN: In regard to the ease with which Mount Everest can be climbed, granting that any one might climb 7000 feet on Mount Everest, from 15,000 feet to 23,000 feet, I think the next 6000, from 23,000 to 29,000, would be a much more difficult affair, because the air is very much more rare the higher you go, and I doubt whether anybody could breathe and undergo the physical strain necessary to climb that last 6000 feet, even if he had the strength. With regard to the suggestion of mountaineers having their camps prepared for them by porters, the question is whether porters could do the work. For reasons given in the paper, I doubt it. As a matter of fact, if the ascent of Mount Everest should be attempted, it is more than likely that its gradients and the natural obstacles would be found to be such as would preclude the possibility of climbing 7000 or 6000 feet in a single day, and a succession of camps would have to be made under the disadvantageous conditions I have mentioned.

The PRESIDENT: In thanking Dr. Hunter Workman for his paper, I need not, I think, say anything more than Sir Thomas Holdich and Dr. Longstaff have said concerning our admiration for the work of himself and Mrs. Workman. I would only ask Dr. Workman to convey this to Mrs. Workman on our behalf.

BATHYMETRICAL SURVEY OF THE FRESH-WATER LOCHS OF SCOTLAND.*

Under the Direction of Sir JOHN MURRAY, K.C.B., F.R.S., D.Sc., etc., and LAURENCE PULLAR, F.R.S.E.

PART XIII.—LOCHS OF THE NESS BASIN.

THIRD PART.

THE first part of this paper, published in July last, dealt with the physical features of Loch Ness, and the second part, published in October, dealt with twenty-seven of the tributary lochs. This third part includes the descriptions of the remaining five lochs, with summary

* Maps, p. 132. The admirable maps which accompany the three parts of the Ness paper (the last of the series) have been presented by Sir John Murray and Mr. Laurence Pullar, and it is thus due to their liberality that we are able to publish them free of any cost to the Society. Though this is the final contribution to appear in the *Journal*, the remaining smaller Scottish lochs are to be dealt with in a special publication to be issued, it is hoped, during this year.—PRESIDENT R.G.S.

table giving particulars of the lochs within the Ness basin sounded by the Lake Survey, to which are appended notes on: I. The temperature of the water in Loch Ness, with a footnote on the chemical composition of the water; II. the seiches of Loch Ness; III. the deposits of Loch Ness; IV. mirages on Loch Ness; V. "storm-weather" at Fort Augustus; VI. the geology of the Ness district; VII. the biology of the lochs in the Ness basin; and VIII. the aquatic vegetation of the lochs in the Ness basin.

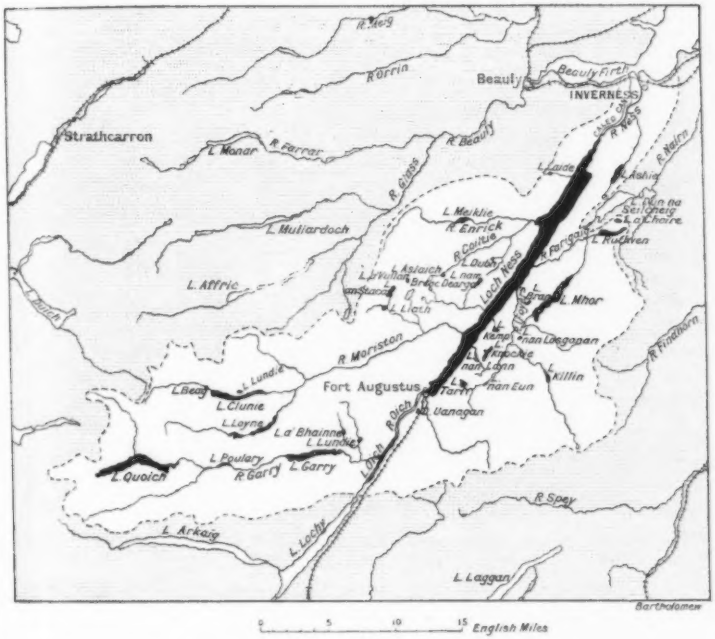

FIG. 1.—INDEX MAP OF THE NESS BASIN.

Loch Mhor (see Plate XIV.).—Loch Mhor is the reservoir for the British Aluminium Co.'s works at Foyers. In its construction advantage was taken of two natural lochs (Garth and Farraline). By means of the dam at the lower end of Loch Garth, the surface of Loch Mhor may be raised to 20 feet above the original level of Loch Farraline, the upper loch. In summer the two lochs may subside to their original levels. The loch is still divided into two portions by a causeway 2 miles from the upper end, and a public road here crosses by a bridge, the water passing by a canal underneath. The loch is rapidly forming a beach by eating away the boulder clay of the fields. These raw cliffs of clay are

exposed when the loch is below its high level, and portions are continually falling in.

Loch Mhor is of very irregular form, narrow and elongate, running north-east and south-west in Strath Errick, the lower end some 2 miles south-east of Foyers. On the west the country is moorland, with low hills, and many patches of trees on the shore of the loch. On the east the hills are higher, rising to mountains at the distance of a few miles. The west shore-line is of a simple outline, with slight double sigmoid curvature. The east shore is much broken up, several bays and arms

FIG. 2.—LOCH MHOR, SOUTH-WEST END, SHOWING THE SHORE WHEN THE WATER IS LOW, WITH REMAINS OF DEAD TREES.

(*Photo. by G. West. From 'Proc. Roy. Soc. Edin.,' by permission of the Council.*)

running south-eastward. The largest of these is in the middle of the loch, and runs three-quarters of a mile inland.

The loch is nearly 5 miles in length, has a maximum breadth of nearly three-quarters of a mile, and a mean breadth of one-third of a mile. It has a superficial area of $1\frac{2}{3}$ square miles. The volume of water is subject to great variation, being estimated at the date of the survey (April 24 and 25, 1903) at 1134 millions of cubic feet. It drains an area of about 21 square miles. Few streams of any importance enter the loch. The largest are the Allt na Seabhaig, which formerly flowed into the river Gourag, but was diverted into Loch Garth when the dam was built, and the Aberchalder burn, which enters the large middle bay on the east. When quite full the reservoir overflows into the Gourag. When surveyed the surface was 638·5 feet above sea-level. In accordance

with its artificial origin, the greater part of Loch Mhor is very shallow; deep water is only found in the original natural lochs. Two-thirds of the whole area is less than 25 feet deep.

The basin formed by Loch Farraline before the surface was raised was fully a mile in length, and one-third of a mile broad, with a depth of about 40 feet. The breadth has been very little increased by the dam. The depth is now 60 feet. The basin is simple, with uniform contours and gently sloping sides. The 25-feet contour encloses an area of two-thirds of a mile long by one-fifth of a mile broad. The

FIG. 3.—LOCH MHOR, SOUTH-EAST SHORE, WHEN THE WATER IS LOW; ROCKS THAT HAVE BEEN DENUDED OF THEIR PEAT COVERING EXHIBIT GLACIAL STRIATION.

(*Photo. by G. West. From 'Proc. Roy. Soc. Edin.,' by permission of the Council.*)

50-feet area is very narrow, a quarter of a mile long, and a little east of the central line.

The basin of Loch Garth, which was $1\frac{1}{2}$ miles long by nearly half a mile broad, is of irregular shape. The main part of the loch was oblong, but a long, curved, narrower part branched off to the south. The depth is now 91 feet (the maximum for Loch Mhor). The 25-feet contour almost coincides with the shore-line of the original loch. The 50-feet contour encloses an area $1\frac{1}{4}$ miles in length, and enters the narrow southern branch. This area is broad for half a mile at the north end, but from there south it is a narrow channel. The 75-feet area is one-third of a mile long by one-fifth of a mile broad. The mean depth of the whole loch is 24 feet.

Series of temperatures were taken in Loch Garth on April 24, and in

Loch Farraline on April 25. The higher temperature of Loch Farraline might be due merely to its being taken a day later, as the weather was warm.

	Loch Garth, April 24, 1903.	*Loch Farraline, April* 25, 1903.
Surface	42°·0 Fahr.	43°·5 Fahr.
10 feet	41°·8 „	43°·2 „
25 „	— „	43°·0 „
30 „	— „	42°·4 „
40 „	41°·2 „	42°·0 „
55 „	— „	42°·0 „
80 „	41°·2 „	— „

Loch Bran (see Plate I.).—Loch Bran is situated in the woods above Foyers, from which it is a mile distant. The shores are wooded, with rock showing in places a little way from the water's edge. There are really two basins at the same level, separated by a narrow neck of land. The loch is very narrow, with the centre line strongly curved. Its length, measured in a straight line, is about three-eighths of a mile, measured round the curve nearly three-quarters of a mile; the maximum breadth is one-fifth of a mile. The superficial area is about 24 acres, and the volume of water 13 millions of cubic feet. The drainage area is only a quarter of a square mile; the loch receives no streams of any size. The east loch drains into the west loch, and that into the river Foyers by a burn half a mile long. The east loch is much the larger and deeper, but the deep area with a maximum of 50 feet is only a little hole in the middle of the loch. The greatest depth in the west loch is 19 feet. The mean depth of the whole loch is 12½ feet. The temperature at the surface on April 30, 1903, was 48°·6 Fahr.; at 10 feet, 46°·2; at 20 feet, 45°·0; at 25 feet, 42°·3; and at 50 feet, 42°·2.

Loch a' Choire (see Plate XV.).—A little loch lying between Lochs Duntelchaig and Ruthven, and draining into the latter. Low but craggy hills border the loch on the west and north, the crags of Creag Dearg facing the west end. The loch is of somewhat oblong form, with the long diameter east and west. The length is nearly two-thirds of a mile, the greatest breadth one-third of a mile, the mean breadth one-fifth of a mile. The superficial area is about 86 acres, and the volume of water 103 millions of cubic feet. The drainage area is nearly one square mile. Only one stream, the Allt Bhreac, flows in on the north, and at the east end the burn flows out towards Loch Ruthven.

Loch a' Choire is 865 feet above the sea. The bottom forms a simple basin, with the deeper water towards the east end. The 25-feet contour follows the shore-line, except at one point on the north where a sounding of 18 feet lies far out. The 50-feet area, one-sixth of a mile in length, lies alt to the east of the centre of the loch. The maximum depth is 60

feet, and the mean depth 27½ feet. The temperature at the surface on April 28, 1903, was 43°·5 Fahr.; at 25 feet, 42°·5; and at 50 feet, 42°·5.

FIG. 4.—WEST END OF LOCH RUTHVEN, LOOKING EAST.
(*Photo. by G. West. From 'Proc. Roy. Soc. Edin.,' by permission of the Council.*)

Loch Ruthven (see Plate XV.).—A loch of fair size, some 2½ miles east of Loch Ness, opposite Urquhart bay, and half a mile south of Loch Duntelchaig. It is a narrow loch, with its central line much curved, but having its general direction east to west. Precipitous wooded hills, the Torr Mòr and the Torr Beag, rise abruptly from the north shore. On the south the crags of Stac Gorm and Craig Ruthven border the eastern part of the loch, while towards the west the ground is lower and more open.

Loch Ruthven is very narrow in the middle, slightly expanded at the east, and much expanded at the west end. The length is 2¼ miles, the maximum breadth, close to the lower end, fully half a mile, and the mean breadth a quarter of a mile. It has a superficial area of about 368 acres, or over half a square mile, and a volume of 180 millions of cubic feet. The drainage area is 4 square miles. The burn from Loch a' Choire comes in near the upper end of the loch, and there are no other burns of any size. The outflowing stream is the river Farigaig, which falls into Loch Ness at Inverfarigaig.

When surveyed on April 27 and 28, 1903, the loch was 2 feet below a bench-mark, 703·1 on the south shore at the upper end, and would therefore be 701·1 feet above the sea. This figure is at variance with

two spot-levels on the north shore where 687 and 688 feet are marked near the west end, and there is no dam to account for so much difference. The Ordnance Survey, on May 8, 1871, made the level 700·4 feet, only a few inches lower than our measurement. Loch Ruthven is on the whole very shallow, having a mean depth of only 11 feet. The small eastern expansion has a flattish sandy bottom, with a greatest depth of 8 feet.

The narrow part, a mile in length, has a uniform central depth of 14 feet throughout, but in it, just three-quarters of a mile from the upper end of the loch, is an abrupt little hole of very limited extent, where the maximum depth of 42 feet occurs. The western basin has a flattish bottom, with a depth of about 13 feet, and two little depressions of 20 and 25 feet. Rock is exposed on the north shore at the bases of the Torrs, and at several points on the south shore. Though the rock is near all along the south shore, the beach is for the most part of gravel and boulders. The river flows out through a grassy flat.

The temperature on April 27, 1903, was 45°·0 Fahr. from top to bottom, and the air at the time was also 45°·0.

Loch Ashie (see Plate II.).—Loch Ashie is used for the water-supply for the town of Inverness. It is about 6 miles south of the town, and 1½ miles east of Dores, on Loch Ness. It is an elongate loch of moderate size, having the same general direction as the Great Glen. The west

FIG. 5.—LOCH ASHIE FROM THE NORTH-EAST, LOOKING SOUTH-WEST, SHOWING BARREN FLAT AND STONY SHORE.

(*Photo. by G. West. From 'Proc. Roy. Soc. Edin.,' by permission of the Council.*)

shore is bordered for its whole length by Drumashie wood; on the east is a bare woodland stretch little higher than the loch.

Loch Ashie is $1\frac{2}{3}$ miles in length. It is nearly half a mile broad in the middle, and narrows towards each end. The mean breadth is one-third of a mile. Its superficial area is half a square mile, and the volume of its water 309 millions of cubic feet. It has a drainage area of nearly 3 square miles. Only a few very small burns go into it, and the Allt Mor, its natural outflow at the north end, flows into the river Ness 2 miles above the town of Inverness.

Loch Ashie forms a simple basin, with all the contours following the line of the shore, and the sides everywhere with a uniform gentle slope. The maximum depth of 51 feet is in the centre of the loch. The mean depth is 21 feet.

The surface on April 14, 1903, was 717·75 feet above sea-level, the water just lipping the sill of the sluice at the north end; the Ordnance Survey, on April 6, 1871, found the level to be 716·0 feet above the sea. On the date of the survey the temperature from surface to bottom was 41°·8 Fahr., the air temperature at the same time being 36°·0.

The details regarding the lochs in the Ness basin are collected together in the table on the following pages for convenience of reference and comparison.

From this table it will be seen that in the thirty-three lochs about 4400 soundings were taken, and that the aggregate area of the water-surface is $34\frac{1}{4}$ square miles, so that the average number of soundings per square mile of surface is 128. The aggregate volume of water contained in the lochs is estimated at 280,923 millions of cubic feet, or less than 2 cubic miles. The area drained by these lochs is about 690 square miles, or twenty times the area of the lochs.

APPENDICES.

I.

NOTES ON THE TEMPERATURE OF THE WATER* IN LOCH NESS.

By E. M. WEDDERBURN, W.S., LL.B.

Regular temperature observations in Loch Ness were begun at Fort Augustus in July, 1903, at the same time as the first limnograph to be used in Scotland was erected. At first the temperature observations were subsidiary to the other observations made in the loch, but gradually their importance increased until the

* The water of Loch Ness was submitted to analysis by Dr. Tetlow, who found nothing abnormal about the water, except its softness and freedom from mineral matter, the total solids being equal to only 2·9224 parts per 100,000 (1·9012 parts of fixed solids, and 1·0212 parts of volatile solids); the principal constituents are sodium and calcium chlorides, while magnesium chloride, iron, potassium, silicon, carbonic acid, and sulphuric acid are present in traces.

SUMMARY TABLE.

Giving Details concerning the Lochs within the Ness Basin.

Loch.	Height above sea. Feet.	Number of soundings.	Length in miles.	Breadth in miles.		Mean breadth per cent. of length.	Depth.			Ratio of depth to length.		Volume in million cubic feet.	Area in square miles.	Drainage area.	
				Max.	Mean.		Max. Feet.	Mean Feet.	Mean per cent. of max.	Max.	Mean.			Total in square miles.	Ratio to area of loch.
Ness	52·60	1693	24·23	1·96	0·90	3·7	754	433·02	57·4	170	295	263,162	21·78	686·31	31·6
Quoich	556·00	280	6·95	0·80	0·43	6·1	281	104·60	37·2	131	351	8,345	2·86	49·18	17·2
Poulary	[320 approx.]	37	1·46	0·20	0·10	6·7	47	9·90	21·0	164	779	39	0·14	82·18	587·0
Garry	257·00	272	4·90	0·56	0·36	7·3	213	78·00	36·6	121	332	3,794	1·75	137·33	78·5
a' Bhainne	[1060 approx.]	42	0·36	0·26	0·14	38·9	28	9·69	34·6	68	196	14	0·05	1·81	36·2
Lundie (Garry) ...	445·40 [Aug. 18, 1869]	103	0·76	0·40	0·22	29·6	54	16·28	30·1	74	246	78	0·17	3·44	20·2
Oich	106·00	195	4·02	0·30	0·19	4·7	154	41·78	27·1	138	509	890	0·76	170·96	224·9
Uanagan	118·20	56	0·52	0·12	0·07	13·5	43	16·80	39·1	64	163	18	0·04	1·21	30·2
Beag	605·20	27	0·30	0·22	0·13	43·3	29	11·80	47·2	63	134	13	0·04	20·40	510·0
Clunie	605·20	126	4·28	0·50	0·26	6·0	123	49·98	40·6	184	452	1,533	1·10	32·29	29·3
Lundie (Clunie) ...	681·50	28	0·46	0·18	0·09	19·6	25	7·80	31·2	97	311	9	0·04	0·95	23·8
West Loch Loyne ...	719·00	67	1·28	0·34	0·19	14·7	19	5·93	31·2	356	1,140	40	0·24	16·21	67·6
East Loch Loyne ...	706·10	123	2·75	0·30	0·15	5·6	35	10·32	29·5	415	1,407	123	0·43	23·87	55·5
An Staca	[1600 approx.]	85	1·02	0·40	0·25	24·5	51	15·52	30·4	106	347	110	0·26	1·23	4·8
Liath	1494·10	43	0·46	0·28	0·21	45·0	55	22·36	40·7	44	109	62	0·10	4·00	40·0
Nam Breac Dearga	[1570 approx.]	60	0·74	0·21	0·12	16·0	70	24·43	34·9	56	160	60	0·09	0·60	6·7
a' Vullan	[1750 approx.]	38	0·45	0·18	0·09	21·6	27	12·27	45·4	88	194	15	0·04	0·69	17·2
Meiklie	364·90	49	1·10	0·43	0·28	25·9	45	22·10	49·1	129	263	193	0·31	41·32	133·3
Aslaich	[1310 approx.]	38	0·35	0·14	0·09	26·9	26	10·91	42·0	71	169	10	0·03	1·62	54·0
Dubh	[1340 approx.]	20	0·18	0·11	0·07	38·9	18	7·00	38·9	53	136	2	0·01	0·17	17·0
Laide	859·80														

Meiklie	[1310 approx.]	38	0·35	0·14	0·09	26·9	28	7·00	38·9	53	136	2	0·01	0·71	35·5
Aslaich	[1340 approx.]	20	0·18	0·11	0·07	38·9	18								
Dubh															
Laide	859·80 [Aug. 4, 1869]	62	0·34	0·32	0·18	52·8	9	5·16	57·3	199	348	9	0·06	1·55	25·8
Tarff	956·20	80	0·69	0·60	0·36	52·5	89	23·89	26·8	41	152	136	0·21	1·20	4·8
Knockie	[nearly 700]	123	1·30	0·46	0·22	16·9	75	24·40	32·5	91	281	194	0·28	1·62	6·0
Nan Lann	[645 approx.]	56	0·70	0·34	0·15	20·8	109	37·03	34·0	34	100	105	0·10	3·69	36·9
Kemp	577·80	48	0·52	0·25	0·20	39·1	51	26·23	51·4	54	105	77	0·11	1·53	13·9
Nan Eun	[915 approx.]	29	0·48	0·18	0·11	23·6	21	9·90	47·1	121	256	15	0·05	3·81	76·2
Killin	[1044 approx.]	61	1·12	0·26	0·18	16·2	67	24·15	36·0	88	245	137	0·20	38·45	192·2
Nan Losganan ..	—	18	0·30	0·10	0·04	12·3	7	3·50	50·0	226	453	1	0·01	0·24	24·0
Mhor (Garth and Farraline)	638·55	279	4·84	0·64	0·35	7·2	91	24·11	26·5	281	1,060	1,134	1·69	20·77	12·2
Bran	—	49	0·74	0·20	0·05	6·9	50	12·63	25·3	78	309	13	0·04	0·28	7·0
a' Choire	865·00	45	0·61	0·33	0·22	36·1	60	27·55	45·9	54	117	103	0·13	0·94	7·2
Ruthven	701·10	103	2·26	0·54	0·25	11·4	42	11·27	26·8	284	1,059	180	0·57	4·01	7·0
Ashie	717·75	50	1·60	0·44	0·33	20·4	57	21·26	37·3	148	397	309	0·52	2·83	5·4
		4385										280,923	34·25	689·14 *	20·1

* With the exception of Loch Ashie, the drainage areas of all the lochs are included in that of Loch Ness.

investigation of lake-temperatures became one of the principal studies of members of the Lake Survey stationed on Loch Ness. The observations were originally made from a rowing-boat by means of the Pullar and Lucas sounding machines and deep-sea reversing thermometers. An endeavour was made to take the observations at regular hours in as nearly as possible the same positions in the loch from day to day, but in stormy weather the keeping of the same position during lengthy observations was attended with considerable difficulty. In September, however, a small decked fishing-boat, called the *Rhoda*, was anchored off Fort Augustus in about 300 feet of water. The anchoring of this boat caused some anxiety, but it was ultimately accomplished by means of a large mushroom anchor, which, with the necessary length of chain, was put at the disposal of Sir John Murray through the courtesy of Mr. Davidson, superintendent of the Caledonian canal.

This boat was primarily intended to accommodate the electrical thermometers which were installed, but it came to be very largely used for taking observations by means of mercury thermometers. Lengthy series of observations could be taken in comfort whatever the state of the weather, and with great economy in time. It was possible to use three or four sounding machines and thermometers at once, and consequently a series of observations could be made much more expeditiously than when only one sounding machine was used.

The electrical thermometers were at first intended to furnish the means of observing continuously radiation into and from the loch. The apparatus was not altogether suitable for this purpose, and, being the first installation of its kind in this country, many unforeseen difficulties arose in the manipulation of the instruments, but nevertheless many valuable observations were made by its means. The installation consisted of three platinum resistance thermometers and a Callendar recorder. The boat-house of St. Benedict's Abbey was made available to the Lake Survey by the Lord Abbot of the monastery, and in it were placed the recording instruments. A four-ply cable connected the recorder with the *Rhoda*, which was anchored at a distance of about 300 yards from the boat-house. Many of the difficulties which were experienced arose from this cable; the strain of the wind and the waves was constantly damaging it, and as the *Rhoda* swung round with the wind great care was necessary to prevent the cable fouling with the anchor chain. On the *Rhoda* there were three large drums, on which were wound the leads for the resistance thermometers. By these drums a thermometer could be lowered to any desired depth, and then connected to the shore-cable by means of mercury cup connections, and a continuous record of the temperature at that depth could thus be obtained. It was intended to lower each of the three thermometers to a different depth, and connect them successively with the recorder, and so to get a series of readings at these depths, but the sluggishness of the recorder made this method of observation undesirable.

Temperature observations were taken at various points along Loch Ness. At times members of the survey were stationed at Invermoriston, Foyers, Inverfarigaig, Whitefield, and Dores. At other times a steam-launch was chartered, and cruises made up and down the loch, taking observations *en route*, but this method of observation was very slow. The speed of the launch was about 6 miles an hour, and, as the loch is 24 miles in length, about eight hours were spent in steaming alone; assuming that six series of observations were taken, each lasting over half an hour, the observations at one end of the loch were taken six or seven hours later than at the other end. It was found that in this time the distribution of temperature in the loch might alter very greatly, and therefore observations made in this manner might give a very erroneous idea of that distribution.

The observations in Loch Ness were discontinued by members of the Lake

Survey in September, 1904, but the work was taken over by the monks at Fort Augustus (in particular by Father Cyril von Dieckhoff and Father Odo Blundell), and continued by them until April, 1905, so that the observations extend over a period of nearly two years. The actual number of observations made in that time was about 12,000, and these have been discussed by the writer in papers communicated to the Royal Society of Edinburgh.* The results arrived at are briefly as follows:—

The yearly cycle of changes in a loch such as Loch Ness is very much the same from year to year. Fig. 6 shows graphically what may be called the typical curves for each month of the year, being drawn from the monthly means of the temperature readings during the period of the observations. From these curves it appears that in September there is the greatest quantity of heat in the loch. Thereafter the loch cools gradually till March or April, when the water again begins to gain heat. This is the time when the mean air-temperature begins to be higher than the surface temperature. From May till August the increase in temperature at various depths proceeds regularly, and the typical curves representing the temperature of the water to a depth of 200 feet are practically straight lines. Below that depth it is probable that the temperature increases less rapidly in proportion to the depth, but even in the deepest waters of Loch Ness there is a range in temperature of about 2° Fahr. The lowest recorded temperatures in the deepest parts of the loch are in April, and the highest in the middle of November. During the period in which the loch gains heat, the most remarkable changes are those taking place at and near the surface. Rapid changes are of frequent occurrence, and are probably due to convection currents. On one occasion the temperature at the point of observation rose 6° Fahr. in two minutes.

When the mean air-temperature falls below the surface temperature, which is usually in August, the loch begins to part with its heat. This is shown in the change of type in the typical curve for September. The surface layers lose heat, while lower down the water still continues to rise in temperature; as already mentioned, the highest temperature at 700 feet was observed in November, or about three months after the loch began to lose heat. In August the discontinuity between the upper and lower layers of the loch usually becomes well marked. As the upper layers of water become colder, there is a layer at the surface of nearly uniform temperature, and of gradually increasing depth. Below this layer there is a sudden change of temperature—a discontinuity-layer—below which there is the colder water in the loch. As the season advances this discontinuity-layer gradually sinks lower, and the layer of uniform temperature above it increases in depth, until finally the whole loch is of nearly uniform temperature.

Before the discontinuity-layer makes its appearance, the currents produced by winds are distributed through the whole loch. There is the surface current, directly produced by the wind, carrying the warm surface water along with it, and the return current, to take the place of the water blown along the loch, is spread throughout the whole depth of the loch. But when the discontinuity-layer has formed, the loch is divided into two current systems. Above the discontinuity-layer there is the surface current produced by the wind, and the return current also takes place above the discontinuity-layer, without directly affecting the deeper waters.

* "The Temperature of the Fresh-water Lochs of Scotland, with special reference to Loch Ness, with an appendix containing observations made in Loch Ness by members of the Scottish Lake Survey," *Trans. Roy. Soc. Edin.*, vol. **45**, p. 407 (1907); "An Experimental Investigation of the Temperature Changes occurring in Fresh-water Lochs," *Proc. Roy. Soc. Edin.*, vol. **27**, p. 2 (1907).

This return current, however, acts on the water below the discontinuity-layer just as the current of wind acts on the natural surface of the loch, and a secondary current is produced at the surface of discontinuity. This secondary surface current is much slower than the surface current produced by the winds, but to take the place

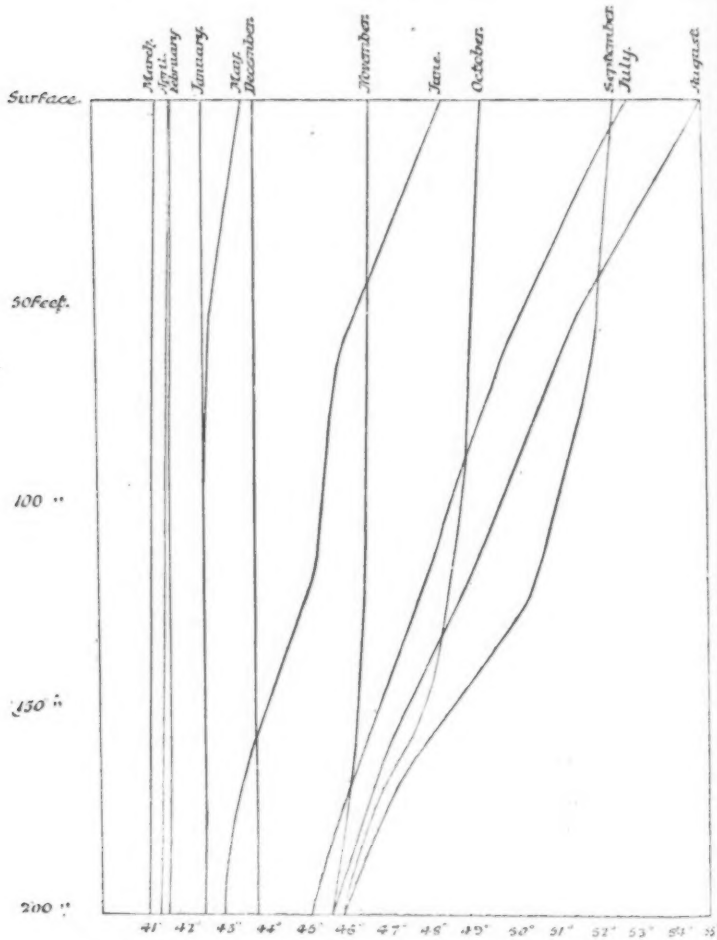

FIG. 6.—TYPICAL MONTHLY CURVES OF TEMPERATURE IN LOCH NESS.

of the water carried along by it, there is a secondary return current at the bottom of the lake. The secondary return current is very slow, and its existence was first suggested to the writer by experiments carried out in a glass trough, but observations support the view taken. The current systems thus described are shown in Fig. 7.

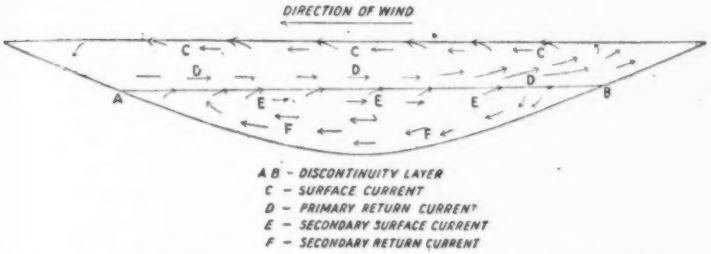

FIG. 7.—CURRENT SYSTEMS IN A LOCH INDUCED BY WIND AT THE SURFACE.

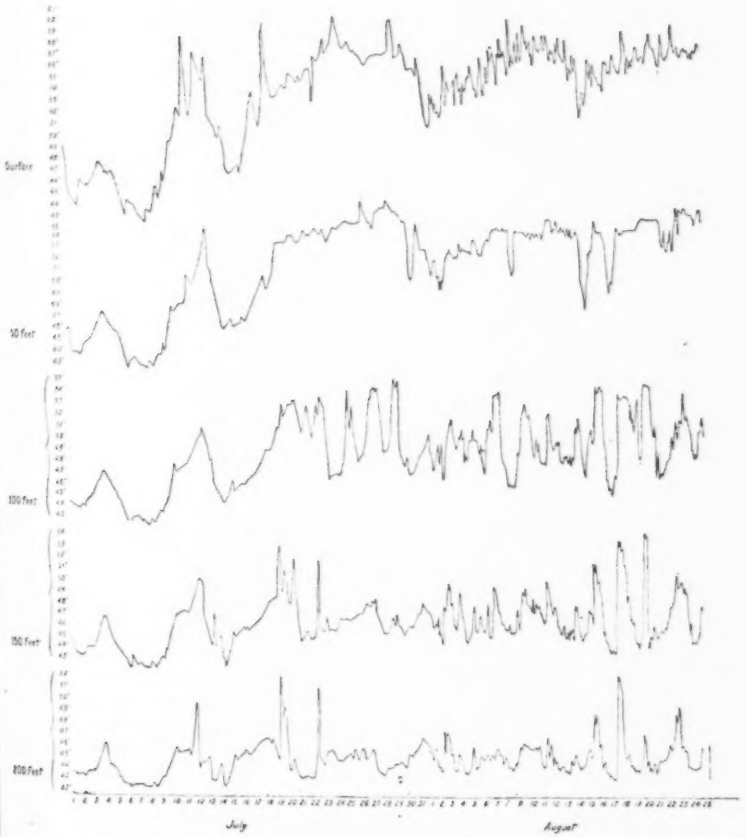

FIG. 8.—TEMPERATURE VARIATIONS IN LOCH NESS AT FORT AUGUSTUS DURING JULY AND AUGUST, 1904.

Another effect of the separation of the loch into two compartments by the surface of discontinuity, is to render possible the temperature seiche. The surface current produced by the wind transfers a large quantity of warm water to the lee end of the loch, with the result that the surface of discontinuity is deeper at the lee than at the windward end of the loch. When the wind moderates or ceases a temperature seiche is started, just as a seiche is started in a basin of water which has been tilted. The temperature seiche was also studied experimentally, and was made visible by superimposing a layer of paraffin on a layer of water. By driving the paraffin to one end of the trough by a current of air, the water, corresponding to the water below the surface of discontinuity in a loch, received a tilt, and when the current of air was stopped, a seiche started in the lower layer of water independently of the upper layer of paraffin.

The temperature seiche was first described by Mr. E. R. Watson in the autumn of 1903, and a good deal of doubt was expressed as to the accuracy of his views, but the theory of a temperature seiche was established by the observations taken in 1904. For a considerable period observations were taken at Fort Augustus every two hours, so as to obtain a continuous record of temperature. Fig. 8 is drawn from the observations taken in July and August, 1904, and shows the temperature variations at Fort Augustus at the surface and at depths of 50, 100, 150, and 200 feet. It will be observed that in July changes at the surface, which are chiefly produced by winds, are accompanied by similar changes at all depths, but that in August, when the discontinuity-layer has been formed, the temperature variations at the surface are independent of the variations at a depth of 100 feet, where the variations are principally due to the temperature seiche.

Observations made at the two ends of the loch further support the theory, as showing that the layer of discontinuity was in general rising at one end when it was falling at the other end. Continuous records obtained from the Callendar recorder are also easily explained by the temperature seiche. Rough calculations were made of what should be the period of this seiche, based on the assumption that the loch contained two layers of waters of different but uniform density. The observed period varied with the time of year, according to the depth of the discontinuity-layer, and was from two to three days, which agrees remarkably with the periods obtained by calculation.

II.

NOTES ON THE SEICHES OF LOCH NESS.

By E. M. WEDDERBURN, W.S., LL.B.

In June, 1903, observations on seiches were begun in Loch Ness by the erection of a Sarasin limnograph in the boat-house of St. Benedict's Abbey, Fort Augustus. This instrument worked well during the period it was in use, and some good records of seiches were obtained. The largest seiche recorded by it occurred on November 21, 1903, and had an amplitude of about $4\frac{1}{2}$ inches, but after about two days it was disturbed by the starting of another seiche.

In the summer of the succeeding year a second Sarasin limnograph was erected at Inverfarigaig, but it did not work satisfactorily—perhaps owing to the exposed situation—and the records obtained were consequently not looked upon as being entirely trustworthy, although, as was to be expected, they pointed to a node in the neighbourhood of Inverfarigaig.

Observations were also made by means of Forel's plemyrameter, but owing to

the exposed character of the shore all along Loch Ness, observation by this means was very difficult. It is unfortunate that the index limnograph subsequently used by Prof. Chrystal had not been designed while work was being carried on in Loch Ness.

The observed periods of the uninodal and binodal seiches in Loch Ness are approximately 31·5 and 15·3 minutes respectively. Loch Ness thus belongs to that class of basins, in which the period of the binodal seiche is less than half the period of the uninodal seiche. The periods for Loch Ness have not been calculated according to Chrystal's theory—an exceedingly laborious piece of work, which it is hoped will yet be undertaken—but the writer has every reason to believe that calculation would agree with observation in this case also. For the basin of Loch Ness is convex at Foyers, where the floor of the loch rises some 200 feet, and, moreover, the sudden shallowing which takes place in the loch from Dores to Bona has the effect of increasing the ratio between the periods of the uninodal and binodal seiches. This is seen in the Lake of Geneva, where there is also a shallowing at one end of the lake, and where the period of the uninodal seiche is more than double the period of the binodal seiche.

Seiches of shorter period were also of frequent occurrence, notably a seiche with a period of about 8·8 minutes, of which some remarkably pure records were obtained, although they were of small amplitude.

Embroideries on the curves were common, and were attributed to a long swell on the loch, to the wash of steamers, and frequently to the opening of lock-gates on the canal at Fort Augustus.

With the view of gaining information on the effect of small variations in atmospheric pressure, a Dines's sensitive barograph was obtained.* Records from an ordinary Richard barograph had indicated sudden barometric changes as a frequent cause of seiches, and the records of the sensitive barograph supported this view to a certain extent, although on some occasions the loch seemed unresponsive to changes in atmospheric pressure. On other occasions, however, the limnograph record seemed to be an accurate reproduction of the record obtained by means of the sensitive barograph.

Loch Ness from its size proved to be rather unwieldy from the point of view of seiches, so that when, in the summer of 1905, the investigation of seiches was undertaken by Prof. Chrystal, he made his headquarters on Loch Earn, and gathered much information as to the cause of seiches from his observations.†

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* The purchase of this instrument was facilitated by a grant from the Moray Bequest to the University of Edinburgh.

† For further details the reader is referred to the following papers:—"On the Hydrodynamical Theory of Seiches, with a Bibliographical Sketch," by Prof. Chrystal, *Trans. Roy. Soc. Edin.*, vol. 41, p. 599 (1905); "Calculation of the Periods and Nodes of Lochs Earn and Treig, from the Bathymetric Data of the Scottish Lake Survey," by Prof. Chrystal and E. M. Wedderburn, *Trans. Roy. Soc. Edin.*, vol. 41, p. 823 (1905); "An Investigation of the Seiches of Loch Earn by the Scottish Lake Survey": Part I. "Limnographic Instruments and Methods of Observation," by Prof. G. Chrystal; Part II. "Preliminary Limnographic Observations on Loch Earn," by James Murray, *Trans. Roy. Soc. Edin.*, vol. 45, p. 361 (1906).

III.

NOTES ON THE DEPOSITS OF LOCH NESS.

By G. W. LEE, D.Sc., and L. W. COLLET, D.Sc., with Analyses of Selected Samples by A. WILSON, F.I.C.

About sixty samples of the deposits covering the floor of Loch Ness were collected by the members of the Lake Survey staff from various parts of the loch, and were examined according to the methods used in the *Challenger* Office for the study of marine deposits.

They may be classed as follows:—

(1) *Dark grey mud*, from the deep basin opposite Urquhart bay;

(2) *Ferrugineous mud*, from the part of the Invermoriston deep basin opposite Horseshoe craig;

(3) *Peaty mud*, from the south-west end of the Invermoriston deep basin;

(4) *Yellow-grey clay*, from off Inverfarigaig and off Cherry island; and

(5) *Brown sand*, from shallow water off Urquhart bay.

(1) Dark Grey Mud.

The eleven samples of this mud are homogeneous and coherent when dry. A typical sample from 740 feet, opposite Urquhart bay, has the following mineralogical composition:—

Minerals (25 per cent.), mean diameter 0·1 millimetre. Of these particles quartz is the most abundant, often coloured red by a coating of iron oxide. Orthoclase, chloritic minerals, and limonite are also present.

Fine washings (75 per cent.), composed of vegetable matter (15·89 per cent.) and clayey matter (59·11 per cent.), with fine mineral particles and limonitic matter.

Chemical Composition.

Total silica	62·36
Ferric oxide	12·27
Alumina	9·38
Lime	tr.
Magnesia	tr.
Loss on ignition	15·89
	99·90

The high percentage of silica is due to the great proportion of quartz. The alumina is due to the presence of felspar and clayey matter. The defect 0·10 per cent. is probably due to the fact that the alkalies have not been estimated.

(2) Ferrugineous Mud.

This type of sediment is limited to the part of the Invermoriston deep basin opposite Horseshoe craig. One of the samples was found after examination to be composed of:—

Minerals (29 per cent.), essentially represented by ferrugineous grains, which are accompanied by quartz, orthoclase, chlorite, and hornblende. These mineral particles are angular, and have a mean diameter of 0·12 millimetre.

Fine washings (71 per cent.), composed of vegetable matter (18·46 per cent.) and fine minerals (52·54 per cent.), belonging to the species mentioned above.

Chemical Composition.

Total silica	37·44
Ferric oxide	24·48
Alumina	15·12
Lime	2·16
Magnesia	1·80
Loss on ignition	18·46
	99·46

The defect 0·54 per cent. is to be sought for in the alkalies.

As there is no clayey matter in this sediment, and as the microscopical investigation did not reveal the presence of many aluminous minerals, the high percentage of alumina, *i.e.* 15·12 per cent., is to be explained by the fact that the ferrugineous grains are not made up of pure iron oxide, but of a mixture of this oxide with clay.

Although manganese was not estimated in the above quantitative analysis, it was found to be rather abundant in another sample.

(3) Peaty Mud.

This type of mud occupies a large area of the floor of the loch in the south-west end of the Invermoriston deep basin.

In order to show the differences in composition due to increase of depth, two descriptions will be given here.

First Sample. Depth 300 feet.

Minerals (35 per cent.), angular, mean diameter 0·2 mm.: orthoclase and acid plagioclase, greenish chlorite in large flakes, quartz, hornblende, and ferrugineous matter.

Fine washings (65 per cent.), composed of vegetable matter (37·10 per cent.) and mineral particles (27·90 per cent.) belonging to the above-mentioned species.

Chemical Composition.

Total silica	47·88
Ferric oxide	5·58
Alumina	7·02
Lime	1·08
Magnesia	0·59
Loss on ignition	37·10
	99·25

Second Sample. Depth 445 feet.

Minerals (10 per cent.), angular, mean diameter 0·12 mm.: orthoclase and acid plagioclase, quartz, chlorite, hornblende, and ferrugineous matter.

Fine washings (90 per cent.), composed of vegetable matter (25 per cent.) and fine mineral particles (65 per cent.) of the same species as those mentioned under the heading: minerals, but chlorite and decomposed felspar are relatively more abundant.

Chemical Composition.

Total silica	46·03
Ferric oxide	10·41
Alumina	7·61
Lime	9·64
Magnesia	1·60
Loss on ignition	24·65
	99·94

Comparing the results of the investigation of these two samples, it will be seen that as the depth increases both the percentage and the diameter of the minerals decrease, the proportion of vegetable matter also decreasing.

The high percentage of lime in the second analysis is probably due to fragments of shells.

(4) Yellow-grey Clay.

One sample was taken off Cherry island in 95 feet, and eight samples off the south-east coast, east of Inverfarigaig, in 250 feet. This is very clayey in character, being soft to the touch and plastic when wet, coherent when dried, and taking in the latter state a light brown streak if rubbed with a hard smooth body.

The Cherry island sample is made up of—

Minerals (1 per cent.), angular, mean diameter 0·1 mm.: quartz, orthoclase, chlorite, and ferrugineous matter.

Fine washings (99 per cent.), composed of clay and very fine mineral particles

Chemical Composition.

Total silica	58·42
Ferric oxide	9·51
Alumina	24·58
Lime	0·52
Magnesia	3·74
Manganese	2·11
Copper oxide	0·65
Loss on ignition	0·59
	100·12

One of the eight other samples is made up of—

Minerals (29 per cent.), angular, mean diameter 0·1 mm.: quartz and decomposed felspar, with a decomposed ferrugineous mineral.

Fine washings (71 per cent.), composed of vegetable matter (4·2 per cent.) and clay and mineral particles (66·8 per cent.).

Chemical Composition.

Total silica	50·94
Ferric oxide	14·76
Alumina	19·80
Lime	6·58
Magnesia	3·61
Loss on ignition	4·20
	99·89

In these analyses the lime and magnesia probably belonged to some ferro-magnesian mineral, which was subsequently transformed into what is given here as "decomposed ferrugineous mineral," the advanced state of decomposition preventing its determination.

(5) Brown Sand.

To four samples of sediment dredged in 30 feet near the coast west of Urquhart bay we give the name of Brown Sand. One of the samples has the following composition:—

Minerals (69 per cent.), angular, mean diameter 0·2 mm., mostly made up of quartz, coloured reddish by a coating of iron oxide. Decomposed mica, hornblende, and plagioclase are also represented. The sand contains a few small fragments of rocks, 1 to 3 millimetres in diameter.

Fine washings (31 per cent.), composed of vegetable matter (4·4 per cent.) and fine mineral particles (26·6 per cent.). There is no clayey matter.

Chemical Composition.

Total silica	77·62
Ferric oxide	3·60
Alumina	5·20
Lime	5·88
Magnesia	2·20
Loss on ignition	4·40
	98·90

The alumina, lime, and magnesia are most likely due to the mica and hornblende, whilst the defect of 1·10 per cent. might represent the alkalies.

Conclusion.

Loch Ness includes two deep basins separated by a barrier formed by the delta of the Foyers river. The muds from the south-western or Invermoriston basin contain a large amount of vegetable or peaty matter, brought down the lake probably by the rivers Tarff and Oich, with mineral particles coming from the disintegration of the rocks, transported by the streams. Small concretions of peroxide of iron and dioxide of manganese were dredged at one station. The muds often gave the characteristic reaction of manganese. On the slopes the muds are sandy, and of a red-brown colour, due to the presence of oxide of iron.

The muds from the north-eastern or Urquhart basin contain far less vegetable matter than those from the south-western basin, which may be due to the Foyers barrier retaining the vegetable matter in the upper basin. In the north-eastern basin the vegetable matter increases with the depth, which is contrary to what is observed in the south-western basin. Off Urquhart bay the contour-lines approach each other very closely, and the vegetable matter brought down the lake by the river Enrick is carried towards the deeper part of the basin. Great differences are observed in the muds from the slopes on the two sides of the loch. On the north-western slope we find especially a red sandy mud, coming without doubt from the washing out of the shore, composed of Old Red Sandstone. On the south-eastern slope we have a fine yellow clay, with fragments of rocks and large mineral particles without vegetable matter. The deposition of the clay in this position may be due partly to the strong prevailing westerly winds of Loch Ness giving rise to waves and currents, which would carry the fine clayey matter brought down by the Inverfarigaig river towards the south-eastern shore. Three stones from a depth of 100 feet, opposite Inverfarigaig pier, were covered with a dark ring of manganese dioxide, marking out the line between the mud and water, as was pointed out by Sir John Murray and Mr. Robert Irvine in their valuable paper: "On Manganese Oxides and Manganese Nodules in Marine Deposits."*

IV.

MIRAGES ON LOCH NESS.

A kind of mirage is one of the most familiar phenomena on Loch Ness, especially in winter and spring. It is best seen in the morning. Distant objects, such as the steamers plying on the lake, appear as though raised above the surface and floating in the air.

* *Trans. Roy. Soc. Edin.*, vol. 37, p. 721 (1894).

The most constant feature of the Loch Ness mirages is seen at promontories some miles distant. The shore-line at the promontories, though really nearly parallel with the horizon, is caused by the mirage to appear to form an angle with the horizon. When this angle is great (say 60° or more), the promontories appear like overhanging cliffs. When the angle is very acute, they seem to be suspended over the horizon. Objects which are known to be below the horizon are brought into view. The receding steamer, after sailing out of sight, will reappear miles further away, raised high above the loch and looking very large. The promontory at Dores appears as a conspicuous island in the middle of the loch. The fathers in the Benedictine Monastery at Fort Augustus tell that on one occasion a snow-covered mountain appeared over the end of the loch. These phenomena are best marked at a distance of several miles from the observer. The steamer, sailing away from the observer, seemed, at the distance of a mile or more, to leave the surface of the loch and sail up into the air.

Signs of the mirage were sometimes to be distinguished at lesser distances. Standing on the deck of the Lake Survey yacht *Rhoda*, when the eyes would be 7 or 8 feet above the water, there could often be seen on the rocks of the nearest parts of the shore a conspicuous horizontal line, looking just like a high-water mark. In the reports of the Balatonsee Commission, mirages of a similar nature are discussed. Von Cholnoky explains how they arise through the formation of a lower stratum of warmer air, heated from the lake. In shallow lakes like Lake Balaton, the mirage is essentially a summer phenomenon. The lake remains warm during the night when the air cools.

In Loch Ness the converse is the case. The great body of water maintains a moderate temperature throughout the year. In summer the lake rarely attains to 60°·0 Fahr., and so the air may frequently remain as warm as the lake, though mirages may occur after any cold night. In winter the lake maintains a high temperature, rarely falling below 42°·0 or 43°·0 Fahr., and thus the air will fall to a much lower temperature almost every night, and a well-marked layer of warmer air be formed by morning over the surface of the lake, giving rise to the mirage.

V.

"STORM-WEATHER" AT FORT AUGUSTUS.

Notes communicated by Dom CYRIL VON DIECKHOFF.

The general features of well-developed "storm-weather" are low barometer, dry haze, wind usually south-east, blowing in isolated gusts ("isolated" with regard to space and time), low strata of cloud forming along lines parallel to the Great Glen, small cumuli forming rapidly in the air and drifting towards the north-west, where they mass and form large strata, often of very dark and threatening appearance. Little or no rain falls during the perfect type, but rain often comes when it breaks up. These small cumuli are well known as indications of gales from the south-east, and are called by the local sailors "Pack-merchants" (*i.e.* pedlars). There are various sub-species of this kind of weather, especially one where the wind is constantly shifting in every direction, the clouds all the while coming from the south-east.

In another type there is a north-east wind (warmer than the ordinary north-east wind), while the clouds come from the south-east. On these occasions the height of the lowest cloud is never much above 3000 feet. There are often several layers at different heights, all in a north-east to south-west direction — even

alto-stratus pieces lie occasionally in this direction: their motion is usually very slow; cirrus comes slowly from the south-west.

"Storm-weather" may occur at any time of the year. The strongest gales, or at least the fiercest gusts, which we get on the loch, come from the south-east. On very rare occasions there has been noticed a kind of reverse to the "storm-sky" during a north-west wind.

VI.

NOTES ON THE GEOLOGY OF THE NORTH-EAST PART OF THE NESS BASIN.

By B. N. PEACH, LL.D., F.R.S., and JOHN HORNE, LL.D., F.R.S.

Only a small portion of the Ness area has been mapped by the Geological Survey. It is situated in the north-east part of the basin, and includes the tract at the mouth of Loch Ness and on either side of the river issuing from that loch. It comprises a small part of Loch Ness, Loch Dochfour, Loch Ashie, Loch Abban, and Loch Laide.

The geological structure of the northern part of the Ness basin is well defined. The basin is traversed by the great fault that runs along Loch Ness, which is continued north-eastwards to Tarbat Ness, thus giving rise to the prominent cliff bounding the Moray firth in the Black Isle. This powerful dislocation, which has been a line of weakness in the Earth's crust at successive geological periods and is evidently related to the earthquake movements that periodically affect the Inverness district at the present time, has a marked downthrow to the south-east. The exact position of the line of fault in the Ness valley is concealed by superficial deposits, but its course probably extends from near the western shore of Loch Ness at Lochend, north-east by Loch Dochfour, Dunean cottage, and Kinmylies, to the Beauly firth east of Kessock ferry.

The effect of this great dislocation in the Ness valley is to let down the Old Red Sandstone strata on the south-east side against the crystalline schists and gneisses of Dochfour hill, the Abriachan granite, and the basal conglomerates and sandstones of Dunean hill and Craig Leach on the north-west. The schistose rocks of Dochfour hill, which are pierced by the Abriachan granite, consist of quartz-biotite-granulites and felspathic gneisses, traversed by numerous veins of pegmatite. Occasional lenticles of garnetiferous hornblende-schist are associated with the gneisses, and a band of limestone also occurs in the schistose series at Blairnahenachrie, west-north-west of Dochgarroch. From their lithological characters, these crystalline schists have been referred to the Moine Series of the Geological Survey, the members of which are regarded as altered representatives of sedimentary deposits.

The triangular area of Old Red Sandstone on the west side of the valley of the Ness, extending from Dochgarroch north-east to Clachnaharry, and west to the Bunchrew burn, consists of coarse conglomerates and grits that dip to the north-west, and are overlain by sandstones, flags, and shales. Along their western margin they are bounded by a fault, with a downthrow to the east, which is probably a branch of the great dislocation running along Loch Ness.

On both sides of the valley of the Ness there is abundant evidence of intense glaciation of the region. On the elevated plateau west of the Ness valley the direction of the ice-movement varied from 25° to 35° north of east. The ice that issued from the Great Glen flowed more or less parallel to the long axis of Loch Ness, that is, in a north-easterly direction, but the trend became more easterly as it

approached the basin of the Moray firth. There is a wide-spread covering of boulder clay, with scattered groups of moraines, along the ridge extending from Dores north-east by Culloden moor. There is also a remarkable development of fluvio-glacial gravels, high river terraces, and remains of raised beaches at the mouth of Loch Ness, on both sides of the valley of the Ness, and on the south shore of the Beauly firth.

Loch Ashie is a shallow lake surrounded by drift, with a fine series of moraines on its eastern side. Loch Laide also occupies a hollow in the drift, with small exposures of crystalline schists in places near its margin. Loch Abban lies in a hollow in the stratified deposits at the mouth of Loch Ness, which may be of fluviatile origin.

VII.

NOTES ON THE BIOLOGY OF THE LOCHS OF THE NESS BASIN.

By JAMES MURRAY.

Collections of plankton were made in twenty-seven lochs in this basin. With the exception of the lochs in the Great Glen itself, most of these lochs are at a considerable elevation, occupying the high tableland on the east of Loch Ness, or the higher mountainous tract on the west.

The situation of the lochs in two alpine masses, separated by the deep cleft of the Great Glen, gives rise to some peculiarities in distribution, most marked in the species of *Diaptomus* and the more conspicuous plankton desmids.

A number of species were only collected on one side of the Great Glen. These peculiarities are probably due to the fact that the lochs to the east of Loch Ness were surveyed in spring or early summer, when the water was still cold, while those to the west were surveyed after midsummer, when they were about at the maximum temperature.

Diaptomus gracilis was here, as elsewhere, almost universal, but was not seen in several of the eastern lochs.

D. laticeps was in Loch Ness and the other lochs in the Great Glen. It was not seen in any loch to the west, but was frequent in lochs to the east of Loch Ness. In Loch Ness the blue *Diaptomus* (identified by Mr. Scourfield as *D. laticeps*) is somewhat small and pale in colour. In other districts, and especially in hill lochs, it is of larger size and brighter colours—blue or occasionally red. There is some doubt as to the identity in all cases, and naturalists have given different identifications of the Loch Ness animal.

D. laciniatus, in contrast to *D. laticeps*, was only found to the west of the glen, in lochs high above the sea. To the east, though it was not in any of the lochs surveyed, it was in some lochans at a great elevation on Carnahoulin.

Desmids.—The conspicuous plankton desmids, which constitute probably the most distinctive feature of the western Scottish plankton, are not very well represented in the lochs of the Ness basin. There are few species, but they include several of the largest and most beautiful. They show no marked preference for the one side of the glen more than the other, but the greatest number of species is in Loch Aslaich, which lies west of Loch Ness.

Micrasterias apiculata, var. *fimbriata*, was in Loch Aslaich, and the var. *brachyptera* was found only once in Loch Ness.

M. radiata, Hass (*M. furcata*).—This very local species was in Loch Aslaich.

Staurastrum furcigerum, Bréb.—In Loch Bran, at Foyers.

S. longispinum (Bail.).—In Loch Aslaich and several neighbouring lochs.

S. ophiura, Lund.—Loch Ness and Loch Aslaich.

S. sexangulare (Bulu.).—Loch Garth, near Foyers.

S. brasiliense, Nordst.—Loch Aslaich.

Euastrum verrucosum, Ehr., *Micrasterias papillifera*, Bréb., *Xanthidium antilopeum* (Bréb.), *Staurastrum gracile*, Rolfs, *Staurastrum lunatum*, var. *planctonicum*, West, and one of the beaked *Closteria*, which I identify as *C. setaceum*, Ehr., are the most generally distributed desmids in the basin.

Crustacea.—Apart from the Calanidæ, a few of the Crustacea appear to be local in the district.

Sida crystallina.—Only seen in Loch Ness and Loch Aslaich.

Diaphanosoma brachyurum.—Only noted in the lochs of the Great Glen and some lochs to the west. The eastern lochs were doubtless surveyed before its season.

Holopedium gibberum.—Noted in scarcely half the lochs, but those on both sides of the Glen and at all elevations.

Leptodora was only seen in the lochs of the Glen and Loch Tarff; *Polyphemus* in the Glen and some lochs to the west; *Bythotrephes* in the Glen and Lochs Tarff and Ruthven to the east.

Rotifera.—Conochilus unicornis was generally distributed; *C. volvox* only in Lochs Ness, Laide, and Knockie.

Floscularia pelagica.—Lochs Ness, Oich, and Uanagan.

Synchæta pectinata.—Lochs Oich and Uanagan.

Anopus testudo.—Lochs Ness and Uanagan.

Triarthra longiseta.—In five lochs on the east side of the basin; apparently a cold-water species.

Gastropus stylifer.—Loch Ness and five lochs to the east, and Loch Aslaich to the west.

Sarcodina.—Clathrulina was not seen except in the lochs of the Great Glen. *Nebela bicornis*, West, though found in Loch Ness, was not got in the plankton, but while dredging in the shallow water of Inchnacardoch bay.

Loch Ness.—Loch Ness was made the subject of a more thorough, though still far from exhaustive, biological investigation than any other Scottish loch. A very large proportion of all the lacustrine organisms known in Scotland have been found in this loch.

The great majority of the species in all the larger groups—Crustacea, Rotifera, Sarcodina—have been got in Loch Ness, the only large group not very fully represented being the desmids. Some of the small groups have hardly been studied, except in Loch Ness, and it is the only loch the abyssal fauna of which is fairly well known.

To give any detailed account of the hundreds of species found in the loch would traverse too much the same ground as the general report on the "Biology of the Scottish Lochs," now in preparation. There will therefore be given here simply an epitome of the biology, and a comparison with the other lochs in the Ness basin.

The Plankton.—The plankton is the average plankton of Scottish lakes, with a very small admixture of the more local species. It is very poor in species, and always very small in quantity. No approach to "flowering" of the water has been noted. The greatest quantity was collected in late autumn, 1903, during the night, when a considerable migration from the deeper water to the surface

evidently took place, as the quantity collected during the preceding day was much less. The plankton varies little throughout the year, a fact probably correlated with the low annual range of temperature, which is less than 20°·0 Fahr., while the upper limit of about 60°·0 is rarely touched.

About half the species of Crustacea remain all the year round, those which are absent in winter being *Bythotrephes*, *Polyphemus*, *Leptodora*, and *Diaphanosoma*. *Holopedium* was noted by Mr. Scourfield, but was never found during the systematic investigation afterwards. *Diaptomus laticeps*, Sars., appears to persist all the year round, and was found carrying eggs in March, when the temperature is at its lowest. *Clathrulina* was generally present, and *Volvox* occasionally.

There is a great contrast between Loch Ness and Loch Lochy in the relative abundance of the phytoplankton. Loch Lochy is very rich, and Loch Ness very poor. The two lochs are only some 10 miles apart, and are apparently under almost identical conditions. Loch Lochy, being in an almost uninhabited district, should be purer than Loch Ness, but a slight pollution is generally favourable to vegetable growth.

Littoral region.—Though there are only a few sheltered bays in Loch Ness, where littoral vegetation can establish itself, the microfauna and microflora found among the larger vegetation are very considerable, and constitute, indeed, the chief part of the species in the loch.

A great many of the animals extend downwards to a very considerable depth, and about forty species (exclusive of Rhizopods), including many Crustacea, Rotifers, Tardigrada, Worms, and the larvæ of many insects, have been collected as far down as 300 feet. Shells of all the Rhizopods extend to the greater depth, and many live at greater depths than 300 feet.

In Inchnacardoch bay Mr. Scourfield found *Ophryoxus gracilis* for the first time in Britain; and the rare *Ilyocryptus agilis*, previously known in several places in England, was got in the same locality.

Abyssal region.—In Loch Ness a large proportion of the littoral species extend to about 300 feet in depth, probably because of the very steeply sloping sides. Those species only are considered as truly abyssal which are generally distributed over the mud, into the deepest part of the loch. A small association of animals is found thus distributed, and the abyssal region, being defined as the bottom where this association is found almost free of admixture, must be considered to begin at about 300 feet. Exclusive of Rhizopods, there are about a dozen animals constantly found in this region, comprising—1 Mollusc, *Pisidium pusillum*, Gmel.; 3 Crustacea, *Cyclops viridis*, Jurine, *Candona candida*, Müll., and *Cypria opthalmica*, Jurine; 3 worms, *Stylodrilus galretæ*, Vejd., *Monotus morgiensis*, Du Plessis, and an undetermined Oligochæte; 1 insect, *Chironomus* (larva); several Infusoria, parasites on the Molluscs and Crustacea.

Several other species occur casually at great depths, such as *Hydra*, *Limnæa*, *Lynceus affinis*, and *Proales daphnicola*.

A small char, *Salmo altinus*, was dredged at a depth of over 500 feet.

Larvæ of *Tanypus* and some other diptera are frequent, but less constant than *Chironomus*.

Rhizopods.—Dr. Penard has identified about forty species and varieties from depths of more than 300 feet. They thus constitute the greater part of the species in our abyssal region, but their presence there is of little special interest, and there are only some half a dozen species and varieties which are doubtfully supposed to be peculiar to deep lakes.

Summary of the Number of Species.

	Species.		Species.
Mollusca	5	Dinoflagellata	3
Hydrachnida	1	Phanerogamia	33
Tardigrada	22	Equisetaceæ	1
Insects	6	Lycopodiaceæ	1
Crustacea	55	Characeæ	2
Rotifera	151	Mosses	6
Gastrotricha	2	Hepatics	2
Worms	12	Florideæ	2
Cœlenterata	2	Chlorophyceæ	46
Infusoria	11	Myxophyceæ (Report in preparation)	—
Sarcodina	67		
Mastigophora	3	Bacillariaceæ	20

We have thus a total of 453 species recorded for Loch Ness, excluding all Vertebrata, blue-green Algæ, and some other groups on which no work has been done. The Hydrachnida, Insecta, Worms, Infusoria, Chlorophyceæ, and Diatoms, have all been insufficiently studied, and the lists could be easily increased.

VIII.

NOTES ON THE AQUATIC FLORA OF THE NESS AREA.

By GEORGE WEST.

From certain points of view, plants may increase in interest and value in ratio to their rarity: of equal worth philosophically are those plants that occur in great abundance. The former, being scattered as individuals, or as small associations over restricted areas, are possibly, at present, of but small import in the economy of nature. The commoner plants, however, by reason of their dominance and abundance, become important agents, not only as a plant-covering to the Earth, but also in the effect they produce in the physiography of a country: barren tracts become heath or forest by the extension of vegetation; lakes are converted into morasses, moors, or even into land suitable for agriculture by the accumulation of plant-remains. Such natural operations tend to increase the wealth and social prosperity of man. As examples on the other hand, the sudden increase of a baneful fungus may bring ruin to thousands of agriculturists, and carry famine to the million; or morasses in hilly districts may slide into cultivated valleys, and completely overwhelm sites of human activity and wealth. These and many other phenomena are brought about by the predominance of certain classes of plants. How great, therefore, are the interests awakened upon the fields of practical thought and knowledge by the abundant and dominant plants in their never-ceasing antagonism with one another and with other forces of nature!

It is chiefly with some of the factors that control the dominant water-plants of higher organization in the Ness area that the following remarks are concerned.

The two great factors that contribute towards the distribution of the plant-covering over the surface of the Earth, and through its waters, are food and climate. Notwithstanding the conditions for plant-life being so often remote from the ideal, yet the plastic power that plants possess of adapting themselves to the various combinations of edaphic and climatic conditions is so great that there are comparatively few spots in which some plant or other is not able to thrive and carry on its metabolic activities. With aquatic plants the influence of the substances, food or otherwise, held in solution in the water, is vastly greater than that of climate.

The edaphic conditions dominating the flora in the majority of the numerous lakes of the Ness area are indirectly influences of climate. Indeed, the rock-basins that contain the lakes are themselves chiefly the result of climatic effects, because they were scooped out during a former period of glaciation. The study of our lake flora brings us, therefore, to consider the cause of a glacial epoch, and is thus the usher to one of the most abstruse and sublime realms of thought that the human intellect has ever been able to grapple with, so complicated and interwoven are the modes of nature's working. But to our more mundane considerations.

The yellow-brown colour of the waters of our highland districts is a matter of common observation, and is due to the water-supply from the mountains percolating enormous quantities of peat before reaching the lakes. This, then, would appear to be an edaphic influence; and so it is, but the existing conditions—the presence of peat on the mountains—have been brought about by direct climatic influence. The climatic conditions that obtain in the exposed portions of the highlands are more favourable to the natural production of moorland than of forest. The two formations—moor and forest—are antagonistic to one another, the tendency being for the moorland to extend from the higher situations over the domain of the natural forest of the lower altitudes. The principal natural causes for this victory of moor over forest are—(1) wind, which is much less antagonistic to moor plants than to trees; (2) the peculiar acid humus that is formed abundantly from the remains of certain dominant moor plants, and which acts inimically towards trees.* These natural conditions have undoubtedly been unwittingly hastened during the past two thousand years by the destructive influence of man on forest.

It is the presence of the peat extract in the water that is the dominating factor governing the aquatic flora of the Ness area. Its presence excludes directly a number of aquatic or semi-aquatic plants that might otherwise thrive. It obliterates any calcium carbonate that might be present, and thus renders the water untenable to calciphilous plants. On the other hand, certain calcifugal plants, having become accustomed to tolerate the presence of humic acids, abound. I scarcely know that one should say the latter thrive the better through lack of competition with the former, because commonly it is not that competition for available space is so great, as that the local conditions favour the dominant production of an individual species.

The peat extract darkens the water, and this restricts the depth zone to which submersed aquatics will grow, because they are unable to carry on photosynthesis beyond a very limited depth, owing to want of light. Therefore the photic zone throughout which there exists sufficient light for the proper development of the higher plants does not extend to a greater depth than about 30 feet in the lochs of the Ness area, and is often very much less than that. The extreme depth to which such plants as *Nitella opaca* and *Fontinalis antipyretica* will flourish in these lakes may roughly be estimated by multiplying by four the greatest depth at which one can see the brown gravel at the bottom, when looking over the shaded side of a boat about midday in the summer, when the sun is shining brilliantly, with the water perfectly calm, and the boat still. Such a depth in Loch Ness is from 7 to 8 feet.

This multiplier, however, does not hold where the multiplicand is considerably greater. Thus at Loch Fiart, on Lismore, one may see the bottom at a depth of 25 feet under the above conditions, but plants do not thrive at a greater depth than 40 to 45 feet. Possibly this is because the less refrangible rays of the spectrum,

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* Space does not permit an explanation here of the involved complications brought about by these factors.

which are most necessary to photosynthesis, become insufficient at greater depths; although the rays of shorter wave-length may penetrate to greater depths in sufficient quantity to fulfil the requirements of the metabolic activities that are dependent upon them. It must be borne in mind that the yellow-brown colour of the peaty lakes probably neutralizes the photo-chemical action of the violet rays at no great depth. We know that Rhodophyceæ thrive in the sea at least to a depth of 250 feet, but in all probability their reddish colour accentuates the photo-chemical action of the very feeble yellow-green rays* that penetrate such a depth of water. In similar manner a photographic plate becomes more sensitive to certain rays when its film is stained with suitable colours. Thus a film stained with erythrosin becomes sensitive to green and yellow. Exact information on these points in various waters of Scotland is much needed.

By reason of the preserving action of humic acids, the organic remains about the shores of the lakes do not readily decay, but undergo a slow process of disintegration, and form a sort of liquid peat. Owing to this action, suitably situated shallow places about peaty lakes become reclaimed by the growth of land-winning plants quicker than in water that is free from humic acids.

The last glacial epoch, after destroying the vegetation of Scotland, immediately began the formation of more numerous lake-basins for the reception of a greater aquatic flora after its disappearance. Not only this, for we find other results of glaciation actually dominating the vegetation in certain of our lochs at the present moment. At Lochs Oich and Lochy, for example, the sides of the adjacent mountains are coated with glacial drift-gravel. This gravel is brought into the lakes by the numerous streams in great abundance, and deposited upon the shores. Under the erosive power of the waves, the constant movement of this gravel upon the littoral entirely prevents the growth of aquatic phanerogams over a considerable area of the margin of the lakes. Again, in many places a steep escarpment, due to glacial action, enters a lake immediately, so that water too deep for phanerogams occurs without any shore whatever; instance Loch Ness opposite Invermoriston, where a depth of 652 feet may be sounded at about 120 yards from the margin. Here we see the indirect effect of a past epoch upon the flora of existing lakes, the lakes themselves being the direct result of that period.

Climate also affects the local distribution of the plants in each loch more or less. The prevailing, and frequently strong, winds are westerly; consequently there is, upon the eastern shore of a lake, a very considerable and oft-recurring wave-action. Acting upon a rocky or stony shore, this erosive power entirely prevents the growth of the higher plants in the shallow water where its influence is felt (see Fig. 5, p. 48). Unless sheltered by adjacent hills, all the lakes will be almost, or quite, devoid of vegetation on their eastern shore, whilst the western shore, and bays sheltered from the prevailing wind, will have an abundant vegetation. The algæ of the seashore may be cited as an example, on the other hand, that plants can develop, and luxuriantly too, on a rocky shore subjected to powerful erosion, but the case is here entirely different. The seeds of phanerogams, excepting the tropical Podostemaceæ, have no power to firmly attach themselves to rocks and stones, as have the spores of seaweeds. Still we do find, even in exposed parts of our lakes, fixed rocks often covered with mosses, hepatics, algæ, etc.

Wind is an important factor in dwarfing the semi-aquatic vegetation about the

* The rays for maximum photosynthesis in the red seaweeds are the yellow-green; these penetrate water sufficiently for photosynthesis to about five times the depth that red rays do.

littoral region of the lakes; especially is this the case with those situated in the more elevated and exposed positions.

The sudden rise of water to any great or prolonged extent is inimical to the well-being of plants in the lochs, particularly so if the water is extremely peaty. This is very pronounced at Loch Mhor, where an ever-changing level—due to the rainfall on the one hand, and the water used by the British Aluminium Company at Foyers on the other hand—does not allow a flora to grow at all. Previously existing trees at the margin have been drowned by the raising of the water-level (see Fig. 2, p. 44).

In these peaty lakes the aquatic plants are usually remarkably free of epiphytic organisms, and also of mud; neither do they bear that deposit of calcium carbonate so common to aquatic plants in lakes that are devoid of the peat extract. Humic acids, and perhaps carbonic acid too, in the waters almost extinguish molluscan life. Consequently one does not find the aquatic vegetation destroyed by these creatures, as is commonly the case where certain of them, especially *Limnæa*, abound.

The great variation between the summer and winter temperature of the water of the higher mountain lochs doubtless affects the flora to a greater extent than in those of lower altitude. These hill lochs are often shallow, and the comparatively small body of water may become heated to 70° Fahr. in summer, and may be frequently covered with ice in winter and spring. The ice often remains upon such lochs until April. Before its final disappearance, large shoals of broken ice grind upon the shores with surprising power and noise, and would destroy any littoral vegetation within its influence. Considering that such floating ice shifts about the loch with every change of wind, it is scant wonder that one so often finds these hill lochs devoid of marginal vegetation. In the great body of water of the large and deep lochs of lower altitude the temperature is more equable, winter and summer records not varying more than 10° to 20° Fahr., and such lochs seldom freeze.

It has already been pointed out that these peaty waters contain little or no calcium bicarbonate. Consequently there is no incrustation of calcium carbonate upon the aquatic plants. A necessary corollary to such antecedents is that no lime deposit resulting from the metabolism of plants is being laid down in these peaty lochs, as is the case where the water is charged with calcium bicarbonate.

The mud occurring in the peaty lakes of the Ness area is seldom of the black evil-smelling kind, such as is commonly found in non-peaty lakes, *e.g.* Duddingston Loch, near Edinburgh. In the latter case the decomposition of organic matter takes place with far greater rapidity than in water charged with humic acids. After the first stages of rapid decomposition comes the formation, among other substances, of ammonia, carbon dioxide, and hydrogen sulphide. It is the last mentioned that gives the mud such an offensive odour when disturbed. In the presence of humic acids this rapid putrefaction does not occur. Instead, the disintegration takes place slowly by a kind of carbonizing process. At the bottom of Loch Ness vegetable remains first become brown, then black and brittle, gradually crumbling to powder, and apparently no obnoxious gas is generated. Putrefaction does not take place, but rather a kind of desiccation—if one may apply this term to a sub-aqueous process. Likewise the mud from the bottom of Loch Ness has not the slightest offensive odour, neither does it stain one's hands as the fetid kind does.

Many plants, *e.g. Phragmites communis*, *Sparganium ramosum*, *Alisma Plantago*, etc., always grow more luxuriantly when the mud is black and fetid; but other species, *e.g. Sphagnum*, various sp., *Isoetes lacustris*, *Lobelia Dortmanna*, etc., are unable to endure that kind of mud, not directly because of its presence, but because other factors, *e.g.* difference in food-salts, are correlated with the presence of this or that kind of mud. A number of other plants are comparatively indifferent, *e.g. Castalia speciosa*, *Menyanthes trifoliata*, etc.

Again, the aquatic vegetation being restricted to the photic zone, the greater portion of the bottom of these deep lakes receives but a small supply of organic remains. The refuse-eating fauna existing at the bottom is consequently able to maintain an equilibrium between supply and demand, so that the lake-bottom consists largely of the non-fetid excrement of these creatures. In shallow non-peaty lakes, whose floor is wholly carpeted with vegetation, *e.g.* Duddington Loch, the supply of organic detritus is greatly in excess of any refuse-eating fauna that may exist, therefore fetid mud results from the process of unhindered decomposition.

From the foregoing statements, it will be readily understood that the flora of the lakes in the Ness area is subjected to many varying conditions, and in order to maintain a proper tone of health a plant has of necessity to respond in suitable ways to all the varying external impressions. A plant is therefore in a constant and continual state of change, owing to the never-ceasing mechanical, physical, and chemical changes of its unstable environment. The plastic nature of many plants enables them to modify their organs in reciprocation to any fairly constant set of environmental conditions; and it is in this endeavour to accommodate themselves for the maintenance of healthy existence in inhospitable places, that certain deviations from the normal forms of more kindly environments are to be accounted for. That such forms should receive definite specific or varietal names is open to grave doubt. Physiologists and experimental botanists are becoming more and more sympathetic towards the simplicity of the astute George Bentham; and whilst recognizing, as did Bentham, the numerous forms fixed and transient, such are regarded as unit forms of the phylogenesis, or of the retrogression of a species.

In many districts one may distinguish mountain lochs by the presence of certain plants, as, for example, *Isoetes lacustris*, *Lobelia Dortmanna*, *Potamogeton polygonifolius*, *Sparganium natans*, *S. minimum*, etc., and by the absence of reeds at the margin. But in the Ness area the presence or absence of such plants and associations is certainly no criterion of the elevation of a loch. All the plants enumerated are to be found at so low a level as Loch Ness (52 feet above the sea); and a reedy margin is found at quite highland situations, whilst it is almost absent in such low-lying lochs as Oich and Ness. The reason is not one altogether of elevation for the presence or absence of certain plants, but is rather due to the supply of food-salts, and the amount of exposure of the water to winds, coupled with the nature of the shore. The mountain lakes usually drain a very small area, poor in food-salts and rich in acid humus; consequently, only those plants are found in them that can obtain their requirements from an apparently scanty food-supply, combined with the presence of humic acids. Such plants are those that have been associated with mountain lakes. Lowland lakes usually drain a wider area, and soils poor in peat and rich in food-salts, which, although indispensable to most plants, are poison to others. In the area of Lochs Ness and Oich there is but a small amount of soil rich in food-salts available for drainage, compared with the soil poor in food-salts and rich in acid humus. Consequently, the effect of drainage from a small, rich food-area is almost extinguished by the humic acids, and in such lowland lochs we find vegetation identical with that of the highest mountain lakes.

Again, in Lochs Oich and Ness (and, of course, others) we have practically no reedy margin, neither have we in many mountain lakes. The reason for this is the nature of the shore, combined with the erosive power of the waves, leaving altogether out of the question food-supply. On the other hand, in mountain lakes with a sheltered peaty or muddy shore, as in lowland lakes of like nature, we find a reedy or sedgy margin. Highland lochs are usually in situations fully exposed to the fierce winds, their shores rocky or stony; consequently, they have few plants

about their margins. Their water, being poor in food-salts and rich in humic acids, has a restricted aquatic flora; but the same conditions may obtain in the lowlands, when the flora of the lakes will be similar. On the other hand, a highland loch having a supply of food-salts, with a suitable shore and sheltered from prevailing winds, may quite well have the character of a lowland loch regarding its flora.*

COAST PEOPLES.

By ELLEN CHURCHILL SEMPLE.

Part I.

Of all geographical boundaries, the most important is that between land and sea. The coast, in its physical nature, is a zone of transition between these two dominant forms of the Earth's surface; it bears the mark of their contending forces, varying in its width with every stronger onslaught of the unresting sea, and with every degree of passive resistance made by granite or sandy shore. So too in an anthropogeographical sense, it is a zone of transition. Now the life-supporting forces of the land are weak in it, and it becomes merely the rim of the sea; for its inhabitants the sea means food, clothes, shelter, fuel, commerce, highway, and opportunity. Now the coast is dominated by the exuberant forces of a productive soil, so that the ocean beyond is only a turbulent waste and a long-drawn barrier: the coast is the hem of the land. Neither influence can wholly exclude the other in this amphibian belt, for the coast remains the intermediary between the habitable expanse of the land and the international highway of the sea. The break of the waves and the dash of the spray draw the line beyond which human dwellings cannot spread; for these the shore is the outermost limit, as for ages also in the long infancy of the races, before the invention of boat and sail, it drew the absolute boundary to human expansion. In historical order, its first effect has been that of a barrier, and for the majority of peoples this it has remained; but with the development of navigation and the spread of human activities from the land over sea to other countries, it became the gateway both of land and sea—at once the outlet for exploration, colonization, and trade, and the open door through which a continent or island receives contributions of men or races or ideas from transoceanic shores. Barrier and threshold: these are the *rôles* which coasts have always played in history. To-day we see them side by side. But in spite of the immense proportions assumed by transmarine intercourse, the fact remains that the greater part of the coasts of the Earth are for their inhabitants only a barrier

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* For further information on the lochs and their plants, see "A Comparative Study of the Dominant Phanerogamic and Higher Cryptogamic Flora of Aquatic Habit, in Three Lake Areas of Scotland" (with 110 illustrations), by George West, *Proc. Roy. Soc. Edin.*, vol. **25**, pp. 967–1023 (1905).

and not an outlet, or at best only a base for timorous ventures seaward that rarely lose sight of the shore.

As intermediary belt between land and sea, the coast becomes a peculiar habitat which leaves its mark upon its people. We speak of coast strips, coastal plains, "tidewater country," coast cities; of coast tribes, coast peoples, maritime colonies; and each word brings up a picture of a land or race or settlement permeated by the influences of the sea. The old term of "coast-line" has no application to such an intermediary belt, for it is a zone of measurable width, and this width varies with the relief of the land, the articulation of the coast according as it is uniform or complex, with the successive stages of civilization and the development of navigation among the people who inhabit it.

Along highly articulated coasts, showing the interpenetration of sea and land in a broad band of capes and islands separated by tidal channels and inlets, or on shores deeply incised by river estuaries, or on low shelving beaches which screen brackish lagoons and salt marshes behind sand reefs and dune ramparts, and which thus form an indeterminate boundary of alternate land and water, the zone character of the coast in a physical sense becomes conspicuous. In an anthropological sense the zone character is clearly indicated by the different uses of its inner and outer edge made by man in different localities and in different periods of history.

The old German maritime cities of the North sea and the Baltic were located on rivers from 6 to 60 miles from the open sea, always on the inner edge of the coastal belt. Though primarily trading towns, linked together once in the sovereign confederacy of the Hanseatic League, they fixed their sites on the last spurs of firm ground running out into the soft, yielding alluvium, which was constantly exposed to inundation. Land high enough to be above the ever threatening flood of river and storm-driven tide on this flat coast, and solid enough to be built upon, could not be found immediately on the sea. The slight elevations of sandy "geest" or plateau spurs were limited in area and in time outgrown. Hence the older parts of all these river towns, from Bremen to Königsberg, rest upon hills, while in every case the newer and lower part is built on piles or artificially raised ground on the alluvium.* So Utrecht, the Ultrajectum of the Romans, selected for its site a long raised spur running out from the solid ground of northwestern Germany into the water-soaked alluvium of the Netherlands. It was the most important town of all this region before the arts of civilization began the conquest by dyke and ditch of the amphibian coastal belt which now comprises one-fourth of the area and one-half

* Rudolph Reinhard, 'Die Wichstigsten Deutschen Seehandelstädte,' pp. 24, 25. Stuttgart: 1901. For Hamburg, see Joseph Partsch, 'Central Europe,' p. 291. London 1903.

the population of the Netherlands.* So ancient London marked the solid ground at the inner edge of the tidal flats and desolate marshes which lined the Thames estuary, as the Roman Camulodonum and its successor Colchester on its steep rise or *dun* overlooked the marshes of the Stour inlet.† Farther north about the Wash, which in Roman days extended far inland over a wide area of fens and tidal channels, Cambridge on the river Cam, Huntingdon and Stamford on the Nen, and Lincoln on the Witham—all river seaports—defined the firm inner edge of this wide low coast. In the same way the landward rim of the tidal waters and salt marshes of the Humber inlet was described by a semicircle of British and Roman towns—Doncaster, Castleford, Todcaster, and York.‡ On the flat or rolling West African coastland, which lines the long shores of the Gulf of Guinea with a band 30 to 100 miles wide, the sandy, swampy tracts immediately on the sea are often left uninhabited; native population is distributed most frequently at the limit of deep water, and here at head of ship-navigation the trading towns are found.§

While, on low coasts at any rate, the inner edge tends to mark the limit of settlements advancing from the interior, as the head of sea navigation on river and inlet it has also been the goal of immigrant settlers from oversea lands. The history of modern maritime colonization, especially in America, shows that the aim of regular colonists, as opposed to mere traders, has been to penetrate as far as possible into the land while retaining communication with the sea, and thereby with the mother country. The small boats in use till the introduction of steam navigation fixed this line far inland and gave the coastal zone a greater breadth than it has at present, and a more regular contour. In colonial America this inner edge coincided with the "fall-line" of the Atlantic rivers, which was indicated by a series of seaport towns, or by the inland limit of the tides, which on the St. Lawrence fell above Quebec, and on the Hudson just below Albany.

With the recent increase in the size of the vessels, two contrary effects are noticed. In the vast majority of cases, the inner edge, as marked by ports, moves seaward into deeper water, and the zone narrows. The days when almost every tobacco plantation in tidewater Virginia had its own wharf are long since past, and the leaf is now exported by way of Norfolk and Baltimore. Seville has lost practically all its sea trade to Cadiz, Rouen to Havre, and Dordrecht to Rotterdam. In other cases the zone preserves its original width by the creation of secondary ports on or near the outer edge, reserved only for the largest vessels, while the inner harbour, by dredging its channel, improves its

* Ibid., p. 301.

† John Richard Green, 'The Making of England,' vol. 1, pp. 51–54; maps, pp. 36 and 54. London: 1904.

‡ Ibid., vol. 1, pp. 12 and 63; maps, pp. xxii. and 54.

§ Friedrich Ratzel, 'History of Mankind,' vol. 3, pp. 97, 139. London: 1898.

communication with the sea. Thus arises the phenomenon of twin ports like Bremen and Bremerhaven, Dantzig and Neufahrwasser, Stettin and Swinemünde, Bordeaux and Pauillac, London and Tilbury. Or the original harbour seeks to preserve its advantage by canalizing the shallow approach by river, lagoon, or bay, as St. Petersburg by the Pantiloff canal through the shallow reaches of Kronstadt bay; or Königsberg by its ship canal, carried for 25 miles across the Frisches Haff to the Baltic;* or Nantes by the Loire ship canal, which in 1892 was built to regain for the old town the West Indian trade recently intercepted by the rising outer port of St. Nazaire, at the mouth of the Loire estuary.† In northern latitudes, however, the outer ports on semi-enclosed sea basins like the Baltic become important in the winter, when the inner ports are ice-bound. Otherwise the outer port sinks with every improvement in the channel between the inner port and the sea. Hamburg has so constantly deepened the Elbe passage that its outport of Cuxhaven has had little chance to rise, and serves only as an emergency harbour; while on the Weser, maritime leadership has oscillated between Bremen and Bremerhaven.‡ So the whole German coast and the Russian Baltic have seen a more or less irregular shifting backwards and forwards of maritime importance between the inner and the outer edges.

The width of the coast zone is not only prevented from contracting by dredging and canaling, but it is even increased. By deepening the channel, the chief port of the St. Lawrence river has been removed from Quebec 180 miles upstream to Montreal, and that of the Clyde from Port Glasgow 16 miles to Glasgow itself, so that now the largest ocean steamers come to dock where fifty years ago children waded across the stream at ebb tide. Such artificial modifications, however, are rare, for they are made only where peculiarly rich resources or superior lines of communication with the hinterland justify the expenditures; but they find their logical conclusion in still farther extensions of sea navigation into the interior by means of ship canals, where previously no water highway existed. Instances are found in the Manchester ship canal and the Welland, which, by means of the St. Lawrence and the Great Lakes, makes Chicago accessible to ocean vessels. Though man distinguishes between sea and inland navigation in his definitions, in his practice he is bound by no formula and recognizes no fundamental difference where rivers, lakes, and canals are deep enough to admit his sea-going craft.

Such deep landward protrusions of the head of marine navigation at certain favoured points, as opposed to its recent coastward trend in

* Joseph Partsch, 'Central Europe,' pp. 284–288. London: 1903.

† H. R. Mill, 'International Geography,' p. 251. New York: 1902.

‡ Rudolph Reinhard, 'Die Wichstigsten Deutschen Seehandelstädte,' pp. 21–22. Stuttgart: 1901.

most inlets and rivers, greatly increase the irregularity of the inner edge of the coast zone by the marked discrepancy between its maximum and minimum width. They are limited, however, to a few highly civilized countries, and to a few points in those countries. But their presence testifies to the fact that the evolution of the coast zone with the development of civilization shows the persistent importance of this inner edge.

The outer edge finds its greatest significance, which is for the most part ephemeral, in the earlier stages of navigation, maritime colonization, and in some cases of original settlement. But this importance persists only on steep coasts furnishing little or no level ground for cultivation and barred from interior hunting or grazing land; on many coral and volcanic islands of the Pacific ocean whose outer rim has the most fertile soil and furnishes the most abundant growth of coco palms, and whose limited area only half suffices to support the population; and in polar and sub-polar districts, where harsh climatic conditions set a low limit to economic development. In all these regions the sea must provide most of the food of the inhabitants, who can therefore never lose contact with its waters. In mountainous Tierra del Fuego, whose impenetrably forested slopes rise directly from the sea, with only here and there a scanty stretch of stony beach between them, the natives of the southern and western coasts keep close to the shore. The straits and channels yield them all their food, and are the highways for all their restless, hungry wanderings.* The steep slopes and dense forests preclude travel by land, and force the wretched inhabitants to live as much in their canoes as in their huts. The Thlingit and Haida Indians of the mountainous coast of southern Alaska locate their villages on some smooth sheltered beach, with their houses in a single row facing the water, and the ever-ready canoe drawn up on shore in front. They select their sites with a view to food supply, and to protection in case of attack. On the treeless shores of Kadiak island and of the long narrow Alaska peninsula near by, the Eskimo choose their village location for an accumulation of driftwood, for proximity to their food supply, and a landing-place for their kayaks and bidarkas. Hence they prefer a point of land or gravel spit extending out into the sea, or a sand reef separating a salt-water lagoon from the open sea. The Aleutian islanders regard only accessibility to the shell-fish on the beach and their pelagic hunting and fishing; and this consideration has influenced the Eskimo tribes of the wide Kuskokwin estuary to such an extent, that they place their huts only a few feet above ordinary high tide, where they are constantly exposed to overflow from the sea.† Only

* Fitz-Roy and Darwin, 'Voyage of the Beagle,' vol. 2, pp. 140, 178; vol. 3, pp. 231–236. London: 1839.

† Eleventh Census, 'Population and Resources of Alaska,' pp. 166–171. Washington: 1893.

among the great tidal channels of the Yukon delta are they distributed over the whole wide coastal zone, even to its inner edge.

The coast Chukches of north-eastern Siberia locate their tent villages on the sand ramparts between the Arctic ocean and the freshwater lagoons which line this low tundra shore. Here they are conveniently situated for fishing and hunting marine animals, while protected against the summer inundations of the Arctic rivers.* The whole western side of Greenland, from far northern Upernivik south to Cape Farewell, shows both Eskimo and Danish settlements almost without exception on projecting points of peninsulas or islands, where the stronger effect of the warm ocean current, as well as proximity to the food supply, serve to fix their habitations; although the remains of the old Norse settlements in general are found in sheltered valleys with summer vegetation, striking off from the fiords some 20 miles back from the outer coast.† Cæsar found that the ancient Veneti, an immigrant people of the southern coast of Brittany, built their towns on the points of capes and promontories, sites which gave them ready contact with the sea and protection from attack from the land side, because every rise of the tide submerged the intervening lowlands.‡ Here a sterile plateau hinterland drove them for part of their subsistence to the water, and the continuous intertribal warfare of small primitive states to the sea-girt asylums of the capes.

In the early history of navigation and exploration, striking features of this outer coast edge, like headlands and capes, became important sea marks. The promontory of Mount Athos, rising 6400 feet above the sea between the Hellespont and the Thessalian coast, and casting its shadow as far as the market-place of Lemnos, was a guiding point for mariners in the whole northern Ægean.§ For the ancient Greeks Cape Malea was long the boundary stone to the unknown wastes of the western Mediterranean, just as later the Pillars of Hercules marked the portals to the *mare tenebrosum* of the stormy Atlantic. So the Sacred Promontory (Cape St. Vincent) of the Iberian peninsula defined for Greeks and Romans the south-western limit of the habitable world.‖ Centuries later the Portuguese marked their advance down the west coast of Africa, first by Cape Non, which so long said "No!" to the struggling mariner, then by Cape Bojador, and finally by Cape Verde.

In coastwise navigation, minor headlands and inshore islands were points to steer by; and in that early maritime colonization, which had

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* Nordenskiöld, 'The Voyage of the Vega,' pp. 327, 334, 335, 365, 366, 412, 416, 459, 467. New York: 1882.

† G. Frederick Wright, 'Greenland Icefields,' pp. 68–70, 100, 105. New York: 1896.

‡ 'Bello Gallico,' book iii. ch. 12.

§ Ernst Curtius, 'History of Greece,' vol. 1, p. 15. New York.

‖ Strabo's 'Geography,' book ii. ch. v. 4; book iii. ch. i. 4.

chiefly a commercial aim, they formed the favourite spots for trading stations. The Phœnicians in their home country fixed their settlements by preference on small capes, like Sidon and Berytus, or on inshore islets, like Tyre and Aradus,* and in their colonies and trading stations they chose similar sites, whether on the coast of Sicily,† Spain, or Morocco.‡ Carthage was located on a small hill-crowned cape projecting out into the Bay of Carthage, and the two promontories embracing this inlet were edged with settlements, especially the northern arm, which held Utica and Hippo,§ the latter on the site of the modern French naval station of Bizerta.

In this early Hellenic world, when Greek sea-power was in its infancy, owing to the fear of piracy, cities were placed a few miles back from the coast; but with the partial cessation of this evil, sites on shore and peninsula were preferred as being more accessible to commerce, and such of the older towns as were in comparatively easy reach of the seaboard established there each its own port. Thus we find the ancient urban pairs of Argos and Nauplia, Troezene and Pogon, Mycæne and Eiones, Corinth commanding its Ægean port of Cenchreæ 8 miles away on the Saronic gulf, to catch the Asiatic trade, and connected by a walled thoroughfare 1½ mile long with Lechæum, a second harbour on the Corinthian gulf which served the Italian commerce.¶ In the same group belonged Athens and its Piræus, Megara and Pegæ, Pergamus and Elaæ in western Asia Minor.** These ancient twin cities may be taken to mark the two borders of the coast zone. Like the modern ones which we have considered above, their historical development has shown an advance from the inner towards the outer edge, though owing to different causes. However, the retired location of the Baltic and North sea towns of Germany served as a partial protection against the pirates who, in the Middle Ages, scoured these coasts. Lubeck, originally located nearer the sea than at present, and frequently demolished by them, was finally rebuilt farther inland up the Trave river.†† Later the port of Travemünde grew up at the mouth of the little estuary.

The early history of maritime colonization shows in general two geographic phases: first, the appropriation of the islet and headland outskirts of the seaboard, and later—it may be much later—an advance towards the inner edge of the coast, or yet farther into the interior. Progress from the earlier to the maturer phase depends upon the social

* Grote, 'History of Greece,' vol. 3, 266–267. New York: 1857.

† Thucydides, book vi. 2.

‡ Grote, 'History of Greece,' vol. 3, p. 273. New York: 1857.

§ Strabo's 'Geography,' book xvii. ch. iii. 13, 14.

‖ Thucydides, book i. 5, 7, 8.

¶ Strabo, book viii. ch. vi. 2, 4, 13, 14, 22.

** Grote, 'History of Greece,' vol. 3, pp. 4, 191. New York: 1857.

†† Rudolph Reinhard, 'Die Wichstigsten Deutschen Seehandelstädte,' p. 23. Stuttgart: 1901.

and economic development of the colonizers as reflected in their valuation of territorial area. The first phase, the outcome of a low estimate of the value of land, is best represented by the Phœnician and earliest Greek colonies, whose purposes were chiefly commercial, and who sought merely such readily accessible coastal points as furnished the best trading stations on the highway of the Mediterranean and the adjacent seas.* The earlier Greek colonies, like those of the Triopium promontory forming the south-western angle of Asia Minor, Chalcidice, the Thracian Chersonesus, Calchedon, Byzantium, the Pontic Heraclea, and Sinope, were situated on peninsulas or headlands, that would afford a convenient anchor ground; or, like Syracuse and Mitylene, on small inshore islets, which were soon outgrown, and from which the towns then spread to the mainland near by.† The advantages of such sites lay in their accessibility to commerce, and in their natural protection against the attack of strange or hostile mainland tribes. For a nation of merchants, satisfied with the large returns but also with the ephemeral power of middlemen, these considerations sufficed. While the Phœnician trading posts in Africa dotted the outer rim of the coast, the inner edge of the zone was indicated by Libyan or Ethiopian towns, where the inhabitants of the interior bartered their ivory and skins for the products of Tyre.‡ So that commercial expansion of the Arabs down the east coast of Africa in the tenth century seized upon the offshore islands of Zanzibar, Pemba, and Mafia, the small inshore islets like Mombasa and Lamu, and the whole outer rim of the coast from the equator southward to the Rovuma river; nor had the sultan's territory expanded a decade ago, when he had to relinquish the long thread of his continental possessions.

But when a people has advanced to a higher conception of colonization as an outlet for national as well as commercial expansion, and when it sees that the permanent prosperity of both race and trade in the new locality depends upon the occupation of larger tracts of territory and the development of local resources as a basis for exchanges, their settlements spread from the outer rim of the coasts to its inner edge and yet beyond, if alluvial plains and river highways are present as lures into the interior. Such was the history of many later colonies of the Greeks and Carthaginians,§ and especially of most modern colonial movements, for these have been dominated by a higher estimate of the value of land.

After the long Atlantic journey, the outposts of the American coast were welcome resting-places to the early European voyagers, but, owing to their restricted area and therefore limited productivity, they were soon abandoned, or became mere bases for inland expansion. The little

* Grote, 'History of Greece,' vol. 3, p. 179. New York: 1857.
† Ibid., vol. 3, pp. 194 and 363.
‡ Ibid., vol. 3, p. 273.
§ Ibid., vol. 3, pp. 195, 197, 275.

island of Cuttyhunk, off southern Massachusetts, was the site of Gosnold's abortive attempt at colonization in 1602, like Raleigh's attempt on Roanoke island in 1585, and the later one of Popham on the eastern headland of Casco bay. The Pilgrims paused at the extremity of Cape Cod, and again on Clark's island, before fixing their settlement on Plymouth bay. Monhegan island, off the Maine coast, was the site of an early English trading post, which, however, lasted only from 1623 to 1626; * and the same dates fix the beginning and end of a fishing and trading station established on Cape Ann, and removed later to Salem harbour. The Swedes made their first settlement in America on Cape Henlopen, at the entrance of Delaware bay; but their next, only seven years later, they located well up the estuary of the Delaware river. Thus for the modern colonist the outer edge of the coast is merely the gateway of the land; from it he passes rapidly to the settlement of the interior, wherever fertile soil and abundant resources promise a due return upon his labour.

Since it is from the land, as the inhabited portion of the Earth's surface, that all maritime movements emanate, and to the land that all oversea migrations are directed, the reciprocal relations between land and sea are largely determined by the degree of accessibility existing between the two. This depends primarily upon the articulation of a land mass, whether it presents an unbroken contour like Africa and India, or whether, like Asia and Norway, it drops a fringe of peninsulas and a shower of islands into the bordering ocean. Mere distance from the sea bars a country from its vivifying contact; every protrusion of an ocean artery into the heart of a continent makes that heart feel the pulse of life on far-off unseen shores. The Baltic inlet which makes a seaport of St. Petersburg 800 miles (1300 kilometres) back from the western rim of Europe, brings Atlantic civilization to this half-Asiatic side of the continent. The solid front presented by the Iberian peninsula and Africa to the Atlantic has a narrow crack at Gibraltar, whence the Mediterranean penetrates inland 2300 miles (3700 kilometres), and converts the western foot of the Caucasus and the roots of the Lebanon mountains into a seaboard. By means of the Arabian sea, the Indian ocean runs northward 1300 miles (2200 kilometres) from Cape Comorin to meet the Indus delta; and then turns westward 700 miles farther through the Oman and Persian gulfs to receive the boats from the Tigris and Euphrates. Such marine inlets create islands and peninsulas, which are characterized by proximity to the sea on all or many sides, and in the interior of the continents produce every degree of nearness shading off into inaccessible remoteness from the watery highway of the deep.

The success with which such indentations open up the interior of the continents depends upon the length of the inlets and the size of the

* W. B. Weeden, 'Economic and Social History of New England,' vol. 1, p. 93. Boston: 1899.

land mass in question. Africa's huge area and unbroken contour combine to hold the sea at arm's length; Europe's deep-running inlets open that small continent so effectively that Kazan, Russia's most eastern city of considerable size, is only 750 miles (1200 kilometres) distant from the nearest White sea, Baltic, and Azof ports. Asia, the largest of all the continents, despite a succession of big indentations that invade its periphery from Sinai peninsula to East Cape, has a vast inland area hopelessly far from the surrounding oceans.

In order to determine the coast articulation of any country or continent, Carl Ritter and his followers divided area by shoreline, the latter a purely mathematical line representing the total contour length. By this method Europe's ratio is 1 linear mile of coast to 174 square miles of area, Australia's 1 : 224, Asia's 1 : 490, and Africa's 1 : 700. This means that Europe's proportion of coast is three times that of Asia and four times that of Africa; that a country like Norway, with a shoreline of 12,000 miles traced in and out along the fiords and around the larger islands,* has only 10 square miles of area for every mile of seaboard, while Germany, with every detail of its littoral included in the measurement, has only 1515 miles of shoreline and a ratio of 1 mile of coast to every 159 square miles of area.

The criticism has been made against this method that it compares two unlike measures, square and linear, which moreover increase or decrease in markedly different degrees, according as larger or smaller units are used. But for the purposes of anthropogeography the method is valid, inasmuch as it shows the amount of area dependent for its marine outline upon each mile of littoral. A coast, like every other boundary, performs the important function of intermediary in the intercourse of a land with its neighbours; hence the length of this sea boundary materially affects this function. Surface and periphery are not dead mathematical quantities, but organs of one body which stand in close reciprocal activity, and which can be understood only in the light of their persistent mutual relations. The division of the area of a land by the length of its coastline yields a quotient which to the anthropogeographer is not a dry figure, but an index to the possible relations between seaboard and interior. A comparison of some of these ratios will illustrate this fact.

Germany's shoreline, traced in contour without including details, measures 787 miles; this is just one-fifth that of Italy and two-fifths that of France, so that it is short. But since Germany's area is nearly twice Italy's and a little larger than that of France, it has 267 square miles of territory for every mile of coast, while Italy has only 28 square miles, and France 106. Germany has towns that are 434 miles from the nearest seaboard, but in Italy the most inland point is only 148 miles

* Norway, Official Publication for the Paris Exhibition, p. 1. Christiania, 1900.

from the Mediterranean.* If we turn now to the United States and adopt Mendenhall's estimate of its general or contour coastline as 5705 miles, we find that our country has 530 square miles of area dependent for its outlet upon each mile of seaboard. This means that our coast has a heavy task imposed upon it, and that its commercial and political importance is correspondingly enhanced; that the extension of our Gulf of Mexico littoral by the purchase of Florida and the annexation of Texas was a measure of self-preservation, and that the unbroken contour and mountain-walled face of our Pacific littoral is a serious national handicap.

But this method is open to the legitimate and fundamental criticism that, starting from the conception of a coast as a mere line instead of a zone, it ignores all those features which belong to every littoral as a strip of the Earth's surface—location, geologic structure, relief, slope, accessibility to the sea in front and to the land behind, all which vary from one part of the world's seaboard to another, and serve to differentiate the human history of every littoral. Moreover, of all parts of the Earth's surface, the coast as the hem of the sea and land, combining the characters of each, is most complex. It is the coast as a human habitat that primarily concerns anthropogeography; and a careful analysis of the multifarious influences modifying one another in this mingled environment of land and water reveals an intricate interplay of geographic forces, varying from inland basin to marginal sea, from marginal sea to open ocean, and changing from one historical period to another—an interplay so mercurial that it could find only a most inadequate expression in a rigid mathematical formula.

As the coast, then, is the border zone between the solid, inhabited land and the mobile, untenanted deep, two important factors in its history are the accessibility of its back country on the one hand, and the accessibility of the sea on the other. A littoral barred from its hinterland by mountain range or steep plateau escarpment or desert tract feels little influence from the land; level or fertile soil is too limited in amount to draw inland the growing people, intercourse is too difficult and infrequent, transportation too slow and costly. Hence the inhabitants of such a coast are forced to look seaward for their racial and commercial expansion, even if a paucity of good harbours limits the accessibility of the sea, and to lead a somewhat detached and independent existence, so far as the territory behind them is concerned. Here the coast, as a peripheral organ of the interior, as the outlet for its products, the market for its foreign exchanges, and the medium for intercourse with its maritime neighbours, sees its special function impaired. But it takes advantage of its isolation and the protection of a long sea boundary to detach itself politically from its hinterland, as

* Frederich Ratzel, 'Deutschland,' pp. 150, 151. Leipzig: 1898.

the history of Phœnicia, the Ægean coast of Asia Minor, Dalmatia, the republics of Amalfi, Venice, and Genoa, the county of Barcelona, and Portugal abundantly prove; and at the same time it profits by its seaboard location to utilize the more varied fields of maritime enterprise before it, in lieu of the more or less forbidden territory behind it. The height and width of the landward barrier, the number and practicability of the passways across it, and especially the value of the hinterland's products in relation to their bulk, determine the amount of intercourse between that hinterland and its mountain or desert barred littoral.

The interior is most effectively cut off from the periphery, where a mountain range or a plateau escarpment traces the inner line of the coastland, as in the province of Liguria in northern Italy, Dalmatia, the western side of the Indian peninsula, most parts of Africa, and long stretches of the Pacific littoral of the Americas. The highland that backs the Norwegian coast is crossed by only one railroad, that passing through the Trondhjem depression; and this barrier has served to keep Norway's historical connection with Sweden far less intimate than with Denmark. The long inlet of the Adriatic, bringing the sea well into the heart of Southern Europe, has seen nevertheless a relatively small maritime development, owing to the wall of mountains that everywhere shuts out the hinterland of its coasts. The greatness of Venice was intimately connected with the Brenner pass over the Alps on the one hand, and the trade of the eastern Mediterranean on the other. Despite Austro-Hungary's crucial interest in the north-east corner of the Adriatic as a maritime outlet for this vast inland empire, and its herculean efforts at Trieste and Fiume to create harbours and to connect them by transmontane railroads with the valley of the Danube, the maritime development of this coast is still restricted, and much of Austria's trade goes out northward by German ports.* Farther south along the Dalmatian and Albanian coasts, the deep and sheltered bays between the half-submerged roots of the Dinaric Alps have developed only local importance, because they lack practicable connection with the interior. This was their history too in early Greek and Roman days, for they found only scant support in the few caravans that crossed by the Roman road to Dyrrachium to exchange the merchandise of the Ægean for the products of the Ionian isles. Spain has always suffered from the fact that her bare, arid, and unproductive tableland almost everywhere rises steeply from her fertile and densely populated coasts; and therefore that the two have been unable to co-operate either for the production of a large maritime commerce or for natural political unity. Here the diverse conditions of the littoral and the wall of the great central terrace of the country have emphasized that tendency to defection that belongs

* Joseph Partsch, 'Central Europe,' pp. 227–230. London: 1903

to every periphery, and therefore necessitated a strong centralized government to consolidate the restive maritime provinces with their diverse Galician, Basque, Catalonian, and Andalusian stocks into one nation with the Castilians of the plateau.*

Where mountain systems run out endwise into the sea, the longitudinal valleys with their drainage streams open natural highways from the interior to the coast. This structure has made the Atlantic side of the Iberian peninsula far more open than its Mediterranean front, and therefore given that western face the lead in maritime affairs since 1450. So from the shores of Thrace to the southern point of the Peloponnesus, all the valleys of Greece open out on the eastern or Asiatic side; here every mountain-flanked bay has had its own small hinterland to draw upon, and every such interior has been accessible to the civilization of the Ægean; here was concentrated the maritime and cultural life of Hellas.† The northern half of Andean Colombia, by way of the parallel Atrato, Rio Cauco, and Magdalena valleys, has supported the activities of its Caribbean littoral, and through their avenues has received such foreign influences as might penetrate to inland Bogota. In like manner, the mountain-ridged peninsula of Farther India keeps its interior in touch with its leading ports through its intermontane valleys of the Irawadi, Salwin, Menam, and Mekong rivers.

Low coasts rising by easy gradients to wide plains, like those of northern France, Germany, southern Russia, and the Gulf seaboard of the United States, profit by an accessible and extensive hinterland. Occasionally, however, this advantage is curtailed by a political boundary reinforced by a high protective tariff, as Holland, Belgium, and East Prussia know to their sorrow.

These low hems of the land, however, often meet physical obstructions to ready communication with the interior in the silted inlets, shallow lagoons, marshes, or mangrove swamps of the littoral itself. Here the larger drainage streams give access through this amphibian belt to the solid land behind. Where they flow into a tide-swept bay like the North sea or the English channel, they scour out their beds and preserve the connection between sea and land; but debouchment into a tideless basin like the Caspian or the Gulf of Mexico, even for such mighty streams as the Volga and the Mississippi, sees the slow silting up of their mouths and the restriction of their agency in opening up the hinterland. Thus the character of the bordering sea may help to determine the accessibility of the coast from the land side.

Its accessibility from the sea depends primarily upon its degree of articulation; and this articulation depends upon whether the littoral

* Elisée Reclus, 'The Earth and its Inhabitants: Europe,' vol. 1, pp. 370-372. New York: 1882.

† Ernst Curtius, 'History of Greece,' vol. 1, pp. 15-20. New York.

belt has suffered elevation or subsidence. When the inshore sea rests upon an uplifted bottom, the contour of the coast is smooth and unbroken, because most of the irregularities of surface have been overlaid by a thick deposit of waste from the land; so it offers no harbour except here and there a silted river mouth, while it shelves off through a broad amphibian belt of tidal marsh, lagoon, and sand reef to a shallow sea. Such is the coast of New Jersey, most of the Gulf seaboard of the United States and Mexico, the Coromandel coast of India, and the long, low littoral of Upper Guinea. Such coasts harbour a population of fishermen living along the strands of their placid lagoons,* and stimulate a timid inshore navigation which sometimes develops to extensive coastwise intercourse, where a network of lagoons and deltaic channels forms a long inshore passage, as in Upper Guinea, but which fears the break of the surf outside.†

The rivers draining these low uplifted lands are deflected from their straight path to the sea by coastwise deposits, and idly trail along for miles just inside the outer beach; or they are split up into numerous offshoots among the silt beds of a delta, to find their way by shallow, tortuous channels to the ocean, so that they abate their value as highways between sea and land. The silted mouths of the Nile excluded the larger vessels even of Augustus Cæsar's time and admitted only their lighters,‡ just as to-day the lower Rufigi river loses much of its value to German East Africa because of its scant hospitality to vessels coming from the sea.

The effect of subsidence, even on a low coastal plain, is to increase accessibility from the sea by flooding the previous river valleys and transforming them into a succession of long shallow inlets, alternating with low or hilly tongues of land. Such embayed coasts form our Atlantic seaboard from Delaware bay, through Chesapeake bay to Pamlico sound, the North sea side of England, the funnel-shaped "förden" or firths on the eastern side of Jutland and Schleswig-Holstein, and the ragged sounds or "Bodden" that indent the Baltic shore of Germany from the Bay of Lubeck to the mouth of the Oder river.§ Although the shallowness of the bordering sea and the sand-bars and sand reefs which characterize all flat coasts here also exclude the largest vessels, such coasts have nevertheless ample contact with both land and sea. They tend to develop, therefore, the activities appropriate to both. A fertile soil and abundant local resources, as in tidewater Maryland and Virginia, makes the land more attractive than

* William Morris Davis, 'Physical Geography,' pp. 115–122. 1899.

† Frederick Ratzel, 'History of Mankind,' vol. 3, p. 95. London: 1898.

‡ Strabo, book xvii. ch. i. 18. Diodorus Siculus, book i. ch. iii. p. 36. Translated by G. Booth. London: 1814.

§ J. Partsch, 'Central Europe,' pp. 96–98. London: 1903. F. Ratzel, 'Deutschland pp. 143–144. Leipzig: 1898.

the sea; the inhabitants become farmers rather than sailors. On the other hand, an embayed coastland promising little return to the labour of tillage, but with abundant fisheries and a superior location for maritime trade, is sure to profit by the accessible sea, and achieve the predominant maritime activity which characterized the mediæval Hanse Towns of northern Germany and our colonial New England.

Subsidence that brings the beat of the surf against the bolder reliefs of the land produces a ragged, indented coast, deep-water inlets penetrating far into the country, hilly or mountainous tongues of land running far out into the sea and breaking up into a swarm of islands and rocks, whose outer limits indicate approximately the old prediluvial line of shore.* Such are the fiord regions of Norway, southern Alaska, British Columbia, Greenland, and southern Chili; the Rias or submerged river valley coast of north-western Spain; and the deeply sunken mountain flank of Dalmatia, whose every lateral valley has now become a bay or a strait between mainland and island. All these coasts are characterized by a close succession of inlets, a limited amount of level country for settlement or cultivation, and in their rear a steep slope impeding communication with their hinterland. Inaccessibility from the land, a high degree of accessibility from the sea, and a paucity of local resources unite to thrust the inhabitants of such coasts out upon the deep, to make of them fishermen, seamen, and ocean carriers. The same result follows where no barrier on the land side exists, but where a granitic or glaciated soil in the interior discourages agriculture and landward expansion, as in Brittany, Maine, and Newfoundland. In all these the land repels and the sea attracts. Brittany furnishes one-fifth of all the sailors in France's merchant marine,† and its pelagic fishermen sweep the seas from Newfoundland to Iceland. Three-fifths of the maritime activity of the whole Austrian Empire is confined to the ragged coast of Dalmatia, which furnishes to-day most of the sailors for the imperial marine, just as in Roman days she manned the Adriatic fleet of the Cæsars.‡ The Haida, Tsimshean, and Thlingit Indians of the ragged western coast of British Columbia and southern Alaska spread their villages on the narrow tide-swept hem of the land, and subsist chiefly by the generosity of the deep. They are poor landsmen, but excellent boat-makers and seamen, venturing sometimes 25 miles out to sea to gather birds' eggs from the outermost fringe of rocks.

As areas of elevation or subsidence are, as a rule, extensive, it follows that coasts usually present long stretches of smooth simple shoreline, or a long succession of alternating inlet and headland. Therefore different littoral belts show marked contrasts in their degree of accessibility to

* For geomorphology of coasts, see William Morris Davis, 'Physical Geography,' pp. 112–136, 347–383. Boston: 1899.

† Elisée Reclus, 'The Earth and its Inhabitants: Europe,' vol. 2, p. 252.

‡ J. Partsch, 'Central Europe,' p. 231. London: 1903.

the sea, and their harbours appear in extensive groups of one type—fiord, river estuaries, sand or coral reef lagoons, and embayed mountain roots. A sudden change in relief or in geologic history sees one of these types immediately succeeded by a long-drawn group of a different type. Such a contrast is found between the Baltic and North sea ports of Denmark and Germany, the eastern and southern seaboards of England, the eastern and western sides of Scotland, and the Pacific littoral of North America north and south of Juan de Fuca strait.

A common morphological history, marked by mountain uplift, glaciation, and subsidence, has given an historical development similar in not a few respects to the fiord coasts of New England, Norway, Iceland, Greenland, the Alaskan "panhandle," and southern Chile. So large subsidence areas on the Mediterranean coasts from the Strait of Gibraltar to the Bosphorus have in essential features duplicated each other's histories, just as the low infertile shores of the Baltic from Finland to the Skager Rack have had much in common in their past development.

Where, however, a purely local subsidence, as in Kamerun bay and Old Calabar on the elsewhere low monotonous stretch of the Upper Guinea coast,* or a single great river estuary, as in the La Plata and the Columbia, affords a protected anchorage on an otherwise portless shore, such inlets assume increased importance. In the long unbroken reach of our Pacific seaboard, San Francisco bay and the Columbia estuary are of inestimable value; while, by the treaty of 1848 with Mexico, the international boundary line was made to bend slightly south of west from the mouth of the Gila river to the coast, in order to include in the United States territory the excellent harbour of San Diego. The mere nicks in the rim of South-West Africa constituting Walfish bay and Angra Pequena assume considerable value as trading stations and places of refuge along that 1200-mile reach of inhospitable coast extending from Cape Town north to Great Fish bay.† It is worthy of notice in passing that, though both of these small inlets lie within the territory of German South-West Africa, Walfish bay with 20 miles of coast on either side is a British possession, and that two tiny islets which command the entrance to the harbour of Angra Pequena, also belong to Great Britain. On the uniform coast of East Africa, the single considerable indentation formed by Delagoa bay assumes immense importance, which, however, is due in part to the mineral wealth of its Transvaal hinterland; but from this point northward for 35° of latitude, a river mouth, like that fixing the site of Beira, or an inshore islet affording protected harbourage, like that of Mombasa, serves as the single ocean gateway of a vast territory, and forms the terminus of a railroad—proof of its importance.

* G. G. Chisholm, 'Commercial Geography,' pp. 444, 446. London: 1904.

† H. R. Mill, 'International Geography,' p. 1012. New York: 1902. Hereford George, 'Historical Geography of the British Empire,' pp. 278–279. London: 1904.

The maritime evolution of all amply embayed coasts, except in Arctic and sub-Arctic regions inimical to all historical development, shows in its highest stage the gradual elimination of minor ports, and the concentration of maritime activity in a few favoured ones, which have the deepest and most capacious harbours and the best river, canal, or railroad connection with the interior. The earlier stages are marked by a multiplicity of ports, showing in general activity nearly similar in amount and in kind. England's merchant marine in the fourteenth century was distributed in a large group of small but important ports on the southern coast, all which, owing to their favourable location, were engaged in the French and Flemish trade; and in another group on the east coast, reaching from Hull to Colchester, which participated in the Flemish, Norwegian, and Baltic trade.* Most of these have now declined before the overpowering competition of a few such seaboard marts as London, Hull, and Southampton; the introduction of steam trawlers into the fishing fleets has in like manner led to the concentration of the fishermen in a few large ports with good railroad facilities, such as Aberdeen and Grimsby, while the fishing villages that fringed the whole eastern and southern coasts have been gradually depopulated.† So in colonial days, when New England was little more than a cordon of settlements along that rock-bound littoral, almost every inlet had its port actively engaged in coastwise and foreign commerce in the West Indies and the Guinea Coast, in cod and mackerel fisheries, in whaling and shipbuilding, and this with only slight local variations.‡ This widespread homogeneity of maritime activity has been succeeded by strict localization and differentiation, and reduction from many to few ports. So, for the whole Atlantic seaboard of the United States, evolution of seaports has been marked by increase of size attended by decrease of numbers.

A well dissected coast, giving ample contact with the sea, often fails nevertheless to achieve historical importance, unless outlying islands are present to ease the transition from inshore to pelagic navigation, and to tempt to wider maritime enterprise. The long sweep of the European coast from northern Norway to Brittany has played out a significant part of its history in that procession of islands formed by Iceland, the Færoes, Shetland, Orkneys, Great Britain, and the Channel isles, whether it was the navigator of ancient Armorica steering his leather-sailed boat to the shores of Cæsar's Britain, or the modern Breton fisherman pulling in his nets off the coasts of distant Iceland. The dim outline of mountainous Cyprus, seen against a far-away horizon from the slopes of

* J. E. Thorold Rogers, 'Six Centuries of Work and Wages,' pp. 123–124. New York: 1884.

† H. R. Mill, 'International Geography,' p. 148. New York: 1902.

‡ Ellen C. Semple, 'American History and its Geographic Conditions,' pp. 121–128. Boston: 1903.

Lebanon, beckoned the Phœnician ship-master thither to trade and to colonize, just as the early Etruscan merchants passed from their busy ironworks on the island of Elba over the narrow strait to visible Corsica.* It was on the eastern side of Greece, with its deep embayments, its valleys opening out to the Ægean, with its 483 islands scattered thickly as stars in the sky, and its Milky Way of the Cyclades leading to the deep, rich soils of the Asia Minor coast, with its sea-made contact with all the stimulating influences and dangers emanating from the Asiatic littoral, that Hellenic history played its impressive drama. Here was developed the spirit of enterprise that carried colonies to far western Sicily and Italy,† while the western or rear side had a confined succession of local events, scarce worthy the name of history. Neither mountain-walled Epirus nor Corcyra had a Hellenic settlement in 735 B.C., at a date when the eastern Greeks had reached the Ionian coast of the Ægean and had set up a lonely group of colonies even on the Bay of Naples. Turning to America, we find that the Antilles received their population from the only two tribes, first the Aruacs and later the Caribs, who ever reached the indented northern coast of South America between the Isthmus of Panama and the mouth of the Orinoco. Here the small islands of the Venezuelan coast, often in sight, lured these peoples of river and shore to open-sea navigation, and drew them first to the Windward isles, then northward step by step or island by island, to Hayti and Cuba.‡

In all these instances, offshore islands tempt to expansion and thereby add to the historical importance of the near-by coast. Frequently, however, they achieve the same result by offering advantageous footholds to enterprising voyagers from remote lands, and become the medium for infusing life into hitherto dead coasts. The long monotonous littoral of East Africa from Cape Guadafui to the Cape of Good Hope, before the planting here of Portuguese way-stations on the road to India in the sixteenth century, was destitute of historical significance, except that stretch opposite the islands of Zanzibar and Pemba, which Arab merchants in the tenth century appropriated as the basis for their slave and ivory trade. So the long gentle curve of the East Indies have been so many off-shore stations whence, first through the Portuguese, and later through the Dutch, European influences percolated into South-Eastern Asia. Asia, with its island-strewn shores, has diffused its influences over a broad zone of the western Pacific, and through the agency of its active restless Malays, even halfway across that ocean. In contrast, the western coast of the Americas, a stretch nearly 10,000 miles from Tierra

* Diodorus Siculus, book v. ch. i. p. 304. Translated by G. Booth. London: 1814. Strabo, book v. ch. vi. 6, 7.

† Grote, 'History of Greece,' vol. 3, pp. 357, 360–366. New York: 1857.

‡ Hans Helmolt, 'History of the World,' vol. 1, pp. 188-189, 193-195. New York: 1902.

del Fuego to the Aleutian chain, has seen its aboriginal inhabitants barred from seaward expansion by the lack of offshore islands, and its entrance upon the historical stage delayed till recent times.

In general it can be said that islandless seas attain a later historical development than those whose expanse is rendered less forbidding by hospitable fragments of land. This factor, as well as its location remote from the old and stimulating civilization of Syria and Asia Minor, operated to retard the development of the western Mediterranean long after the eastern basin had reached its zenith; but in this eastern basin, again, the paucity of islands and unbroken contour of its southern half gave a meagre history to all its shores lying south of Cyprus, Crete, and Malta.

(*To be continued.*)

REVIEWS.

ASIA.

A Journey in North-Eastern Tibet.

'Das Rätzel des Matschu. Meine Tibet Expedition.' Von Wilhelm Filchner. *Maps and Illustrations.* Berlin: Mittler. 1907.

'Das Kloster Kumbum in Tibet.' By the same. *Maps and Illustrations.* Berlin: Mittler. 1906.

'Wissenschaftliche Ergebnisse der Expedition Filchner nach China und Tibet, 1903-05.' X. Band, I. Teil. Berlin: Mittler. 1908.

The journey of which these works are the outcome was in many ways a remarkable one. It was undertaken, not for mere purposes of sport or adventure, but with a fixed determination on the part of the author to achieve a piece of work which it might take all his manhood to accomplish. Having set himself a definite task, he spared no pains to qualify himself for its execution, and allowed no difficulties to deter him from carrying it through when begun. The chosen field was, as he claims, at the time of his setting out, the most important unknown area in the whole of interior Asia—that traversed by the upper course of the Hwang-ho, and stretching southward from this towards the mountainous border of northern Sechuan: and, although unable to carry out every part of his programme, he was successful in stretching a line of survey across the very centre of this little-trod region.

Lieut. Filchner had the advantage of two zealous coadjutors in his work. His wife—who accompanied him to the threshold of Tibet, and during his further journey spent an anxious time of waiting in the family of Mr. Ridley, an English missionary at Sining-fu—gave substantial help in the formation of the botanical, zoological, and ethnological collections, besides keeping up a regular series of meteorological observations during her residence at Sining. His other companion, Dr. Tafel, whose own recent journey has been frequently referred to in these pages, undertook the geological researches, and was able to bring together a large collection of rock-specimens. The leader himself was fully occupied with the route survey, astronomical determination of positions, altitude determinations, meteorological observations made three times daily, magnetic observations at forty-two stations, and photographic work, besides botanical and zoological collections. The working up of all this material has been a task of considerable magnitude, but being attached (through the influence of the late Baron von Richthofen, a constant supporter of the

whole undertaking) to the trigonometrical division of the general staff at Berlin, Lieut. Filchner enjoyed special facilities and expert co-operation in carrying it through. The more serious results will eventually occupy a number of volumes, of which two have so far appeared, while a general narrative is supplied in the first of the works above recorded.

The story told in this volume cannot fail to rivet the reader's attention, especially in the Tibetan portion, where the fate of the party and the success or failure of the venture seem throughout to be hanging in the balance. The route across China, though necessarily of less dramatic interest, was far less hackneyed than many that have been described of late years. It led up the swiftly flowing Han river (where the German traveller seems to have preceded Colonel Manifold's party by a few weeks only) to Hingan-fu; across the rugged Chin-ling or Tsin-ling range to Sian-fu; and thence *viâ* Lan-chou to Sining-fu, where the final organization of the Tibetan expedition took place. The journey was comparatively uneventful until the upper Hwang-ho (Tibetan Machu) was reached, but here the real troubles began. It was found impossible to cross the river, in spite of several gallant attempts by Dr. Tafel to swim across with a rope, and it was necessary to ascend it almost to its outlet from the Oring-nor. The country of the dreaded Ngolok, into which the expedition was about to venture, lay on the farther side, but as it was hoped to disguise from these the presence of Europeans in the caravan, it was decided to make a southward *détour* so as to approach the Ngolok country from the direction of Lhasa. This ruse was hardly a success, for the party were viewed with more or less suspicion from the first, and the time that followed was one of unceasing anxiety. There is something almost farcical in the account of the travellers' distresses. Their disguise (or at least that of Lieut. Filchner) seems to have been of the flimsiest nature, yet we find them endeavouring to keep it up after being frequently denounced as Europeans; driven at times to hiding in their tents, and allowing their servants to pose as the owners of the caravan, or having desperate recourse to a story that their boxes were filled with soldiers armed to the teeth. Although in certain cases they were received with unexpected hospitality, a state of more or less open hostility was the rule, and on the occasion of a night attack, they had to stand to be fired at for hours, at a temperature many degrees below freezing. Yet, though constantly in the power of the Ngolok, these show a strange reluctance to proceed to extremities, and when at last they are made prisoners by the chief of Waserr, they find in their captor a friend who materially assists them in completing their undertaking. A great part of their difficulties seems to have arisen from the total lack of sympathy between the Europeans and their Chinese followers, and one is tempted to ask whether an open avowal of their true character might not have been after all the better policy.

During this journey the Machu was followed with great determination almost to its great northerly bend, when its banks became quite impracticable. Even at this early stage, the river is remarkable for the amount of sand it carries down. Lieut. Filchner was untiring in carrying on his surveys, and his success as a photographer is shown by the exceptionally good views of the country traversed. The people themselves and the objects in use among them are also well illustrated. The Ngolok seem a typical race of steppe-dwellers, though there are some large and (for the nature of the country) dense aggregations of population. They are described as born soldiers, with a keen eye for country, and as possessing more character and independence than their Chinese neighbours. Some trade is carried on amongst them by Chinese Mohammedan merchants, with whom the travellers frequently came in contact. The maps in the volume are very rough, but the cartographical results are to be published separately.

In his volume on the Kumbum monastery—the first of the special monographs on the results of the journey—Lieut. Filchner gives the most complete account that has yet appeared of its present condition and its history. The other volume above referred to describes the zoological and botanical collections.

Central Asia.

'In the Footsteps of Marco Polo: Being the Account of a Journey Overland from Simla to Pekin.' By Major C. D. Bruce, late Commanding the Chinese Regiment of Infantry. Edinburgh and London: William Blackwood & Sons. 1907.

This interesting description of a long and, in places, rough journey deserves and we hope will obtain, considerable popularity, for it appeals to all sorts and conditions of men. To geographers because, as often as was possible, an untrodden or little-known route was selected, and the countries visited from the desert of Takla Makan onward have at present, for such persons, special interest. History readers will find much information respecting Buddhism; Chinese intercourse with India, Tibet, and Turkistan; and the ancient history of China. Others more interested in the present than in the past, will find a great coalfield in Kansu described. Baron von Richthofen has said that it was one of the most remarkable in the world, but had two great disadvantages: distance from the sea or navigable rivers, and being situated a few thousand feet above the adjoining plain. English enterprise, if not thwarted by Chinese prejudice and obstruction, might surely be equal to finding a profitable solution.

Again, that strange deposit, so interesting to students of physical geography, known as the loess formation, was met, and a long description of it by Baron v. Richthofen is quoted. The relations between the three empires chiefly concerned in Central Asia, the policy followed, and other matters, are touched on with commendable restraint. In this volume, therefore, there is no want of food to suit many tastes.

Major Bruce makes some sound remarks on the religion of Ladákh; he says, "The Ladakis who inhabit this country differ considerably from the Kashmiris. The former profess Buddhism, but, be it said at once, a form which bears hardly any resemblance to the elevating and mystic faith which Buddha once taught.

"The actual religion of Ladak is a modified form of Indian Buddhism, and was introduced more than two thousand years ago. It is contained in a voluminous work called the 'Kah-Gyur,' or 'Translation of Precepts,' because it is a version of the precepts of 'Sakya' made from the Indian language."

He gives further particulars, and mentions a mission from Leh to Lhasa "known as the Lapchack Mission." It is of old standing, and is sent every third year, and was payment of tribute as well as a commercial enterprise. Now the British authorities consider it has no political signification, but that view is probably not held by the Tibetan rulers, who regard it as *nazar*, or tribute. The distinction, as matters now stand, is unimportant, but if ordinary advantage had been taken of the Younghusband mission, the British Government would have been, sooner or later, the protecting power; thus at the same time assuming superiority, and, through Kashmir, paying tribute; a situation savouring of comic opera.

The journey of Major Bruce's party may be divided into three main parts: from Simla to the Tibetan frontier at the top of the Lanak pass, Chang Chenmo valley; thence *viâ* Kiria to Su-chau, the first town met in China proper; and from Su-chau to Peking. The first part calls for no special notice, but there is much interest at present felt in the second part. For not only is the question of the battle between the sands of the desert and the water from the snows involved, but recent archæological research, chiefly under Dr. M. Aurel Stein, happily still in progress, has

brought to light many manuscripts and relics which are expected to throw light on matters more or less obscure. Of the boundaries of this tract the major says, "The geographical area commonly known as Chinese Turkestan is a somewhat vague one. By some geographers it is considered to embrace the larger portion of the western extra-mural Chinese Empire. By others the area so described is confined to the basins drained by the streams which run into Lopnor, as well as by those which lose themselves in the great central desert, the Takla Makan.

"From the Chinese point of view the latter are more nearly correct, the territory being always known to the people of that vast empire as the Hsing Chiang, or new frontier."

Whilst travelling along the southern side of the Takla Makan some sport, of which there is an animated description, was had about Nia, and the fact of passing to the south of the terminal lake of the combined waters from both sides of the desert has led to remarks on the Lob-nor controversy. That is, we hope, practically set at rest by the explanation that the lake is and was a changing and migrating body of water, and that now, not improbably, it is returning to the old site, as shown in ancient Chinese records.*

In instances the names in the text do not agree with those in the maps, in which Umrutsi is found for Urumtsi; but on the whole the book is fairly free from misprints, and is well turned out.

W. Broadfoot.

A Dutch Voyage in the Persian Gulf.

'Cornelis Cornelisz Roobacker's Scheeps-Journaal, Gamron-Basra (1645); de eerste Reis der Nederlanders door de Perzische Golf.' Edited by A. Hotz. Leiden: Brill. 1907.

In 1645 Wollebrandt Geleynsz de Jongh, the President of the Dutch factories in Persia, decided to follow the example of the English in establishing a factory at Basra. Two small ships—the *Delfshaven* and the *Schelvisch*—were accordingly despatched with a cargo of merchandise under the charge of Dirck Sarcerius. They sailed towards the end of June, reached their destination a month later, and landed their merchants, who, having obtained favourable terms from the Turkish governor, started their factory with every prospect of success. The *Delfshaven* sailed on her return voyage in September, and anchored at Gombroon on October 5. Her master, Cornelis Roobacker, had, of course, kept a careful journal of the voyage—the first undertaken by the Dutch in the Persian gulf—and this has now been printed by the Royal Geographical Society of the Netherlands. The original is missing, but use has been made of a transcript which was carried home by Geleynsz, and after his death passed, with others of his papers, into the possession of the municipal authority of Alkmaar, his birthplace. From their custody it was last year transferred to the Rijksarchief at the Hague.

The journal itself is of the usual character—a terse, straightforward narrative of the voyage, with special stress on matters relating to navigation. It has been admirably annotated by the editor, Mr. A. Hotz, who has also provided a copious and learned introduction, with a full list of books and maps dealing with the Persian Gulf and its trade. A special feature is the reproduction in facsimile of a contemporary chart of the Gulf—possibly by Roobacker himself—which is now in the library of Leiden University.

W. F.

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* *Geogr. Journal*, vol. 27, p. 610.

AFRICA.

Africa from South to North.

'A Woman's Trek from the Cape to Cairo.' By Mary Hall. *With 64 Illustrations and two Maps.* Methuen & Co., London. 1907. *Price* 16*s. net.*

Miss Mary Hall is the first woman to have crossed Africa from south to north, and her account of how she managed to do it is not only well written, but full of useful information. A glance at her route as marked on the map shows that between Beira and Chinde the "trek" was by sea, and it appears that the journey was accomplished in two stages. In 1904 Miss Hall travelled extensively in South Africa; in 1905, starting from Chinde, she journeyed to Port Said by way of the great lakes and the Nile. She did not go as an explorer, or in furtherance of any scientific object such as zoology, or botany; simply as one who is interested in fresh countries and peoples, and considers travelling "the most delightful method of studying geography." Miss Hall has an observant eye, especially for the physical features of the countries through which she passes, and for the peoples with whom she comes in contact. Travelling through Nyasaland, through part of German East Africa, and also through Uganda to Gondokoro, as well as going down the Mombasa railway as far as Nairobi, she everywhere noted the progress being made by Europeans and the manner of life of the natives. There is probably no other book which gives so sympathetic yet accurate a picture of the condition of the regions named as is portrayed in Miss Hall's pages. This is interwoven with an account of her own adventures, the whole being set down without a trace of exaggeration. Miss Hall, on one of her *safaris*, that between Usumbura on Lake Tanganyika and Bukoba on Victoria Nyanza, traversed country little known and inhabited by somewhat hostile tribes. Here, as elsewhere, she proved herself intrepid, resourceful, and tactful. Perhaps the most striking thing about the book, to the thoughtful reader, is the evidence it affords of the very great influence being exercised by the various Christian missions in East Equatorial Africa—and similar influence is being wielded in other parts of Negro and Bantu Africa. Miss Hall's testimony is that the work of the missionaries is not only beneficial, but fruitful. This is especially the case in Nyasaland and Uganda. One result is that over large areas native customs are fast being modified. To the ethnologists this change may be distasteful, but it should also stir him up to make greater efforts to study African culture before it is too late. For the rest we are thankful to get the views of a highly cultured woman on the tribes of Central Africa, and on the amenities of travel in realms still unhackneyed. Miss Hall ends her narrative at Khartum, and almost her last words are about General Gordon, and bear eloquent testimony to the indelible mark that remarkable man made upon the country which once he ruled. "A lady missionary," she writes, "a good Arabic scholar, told me that she had often heard the natives, as they stood beneath it [the statue of Gordon seated on a camel], talking to the great soldier and asking him why he did not come down and speak with them." There are numbers of excellent illustrations of native types, and two sketch-maps.

F. R. C.

African Languages.

'Bantu Phonetics.' By the Rev. E. Jacottet. Lovedale Mission Press. 1907.

I believe I am correct in assuming that the author of this supplement to the *Christian Express* of September, 1907, is likewise the author of the grammar (in French) of the Subiya and Luyi languages of the upper Zambezi. This last-named work is one of the sanest and most illuminating studies of that fascinating subject—the Bantu languages, their origin and inter-relationship.

The supplement under review is little else than a summary and appreciation of three of Carl Meinhof's admirable linguistic studies—'Grundriss einer Lautlehre der Bantu-sprachen,' 'Grammatik des Tshi-venda,' and 'Hottentotische Laute, etc., im Kafir.' M. Jacottet, in his 'Bantu Phonetics,' does not do much more than reproduce with interesting comments the conclusions arrived at by Meinhof on the sound-changes of the Bantu languages. It is in this direction that the present writer (possibly through some defect in his own intelligence) feels the least cordial admiration for Meinhof's work. Meinhof is becoming one of the leading authorities on the structure, analogies, and relationships of the Bantu languages. He has revealed to our knowledge dialects or speech-groups scarcely if at all illustrated before. Some of his writings on the mysterious and hitherto unclassified East African languages, which are dotted in isolated enclaves amongst the Bantu languages in Eastern Equatorial Africa, are specimens of remarkable and illuminating research. But the "reviewer of this review" feels obliged to repeat here what he has said in the journal of another society, that, in his opinion, German philologists are wasting a certain amount of time and energy (besides confusing those less deeply instructed) by splitting hairs on the subject of variations in the pronunciation of consonants and vowels in the Bantu languages. They would like, for example, to distinguish between the different kinds of *t* in the Swahili language or in other forms of Bantu speech. They exasperate the reader's eye by unnecessary accents on vowels, attaching tremendous importance to the difference between *i* and *i*. The letter *v* is marked above and below in all sorts of ways, because the German philologist has not the courage to call it a *b*. There is this kind of *k* and that kind of *k*. There are several sorts of *m* and *l* and *n*, of *r* and *g*. Now, the only result of this preciosity is that the exasperated beginner, or even the person who is halfway advanced in his African language-studies, lays down the German manual or grammar in despair. His mind cannot grapple with the infinitely varied instructions as to how to pronounce this consonant and that vowel. So he gives up (it may be) a study which is one of the most profound interest, because in the dissection and comparison of these Bantu languages is locked up a vast deal of unwritten African history.

The same plague in a more acute form—amounting, in fact, to a mania—affects the transliteration of North and South American languages. This affectation reached its highest development, perhaps, in the *Journal of the Royal Anthropological Institute* two or three years ago. There was one author (whose name I do not remember) whose transliteration of Alaskan languages was a masterpiece of mystification. Capital letters, lower-case letters turned upside down, weird accents, Greek letters, Arabic letters, German letters, were all (as it were) thrown into a hat, shaken up, and cast on to a page. In all probability, nobody but the author of the article would be able to pronounce and read the sounds he intended to describe.

Now, this is all vexatious nonsense, and it is time it was put a stop to. As a general rule, to which there are very few exceptions, every reasonable sound uttered by the human voice can be expressed by Lepsius' standard alphabet, and for ordinary purposes it is really not necessary even to go into the furthest refinements of Lepsius, except it be in some special manual intended to teach very accurately the exact pronunciation of a language.

Let this premise be admitted which I am about to express, and the whole of the Bantu languages can be written with the simplest form of the Lepsius alphabet, and that again, with a slight revision, is merely the Roman alphabet with one or two borrowed Greek letters. And the premise is this: that there is no doubt a good deal of variation—individual and tribal—in the exact pronunciation of consonants and vowels, of the letter *t* (for example). Sometimes the *t* is slightly

aspirated (as it is in a good many Indian words), sometimes it is pronounced in a saccadé fashion, as it is in the dialect of Glasgow. It easily crumbles into an *r* or softens into a *d*, and suddenly changes from *t* in one dialect to *s* or even *k* in another, closely related, and alongside. *R* and *l* interchange so constantly that they are practically the same letter. *R* and *d* take one another's place with the greatest facility; likewise *d* and *l*. It is often difficult to distinguish (when issuing from the mouth of a Bantu) *Dueru* from *Luelu*. The vowels permute also with some facility, though, as a rule, there is greater constancy in the life of vowel sounds than in the use of consonants. But take, for example, the Bantu for "shield." It is difficult to say whether in the original Bantu it was *ngabu* or *nguba*. In Kongo it is Ngubu, and in Swahili it is Ngao. In many other Bantu languages it is *ngabo*, and in yet many others it is *nguba*. *A* changes easily into *e*, *o* into *u*, *u* into *i*, and so on.

Amongst consonants, *g* often crumbles into *γ*, and *k* into *χ*, *ng* into *nd*, *nz*, or *nj*; *s* into *š*. *F* is frequently the rendering in one dialect of *sw* in another; or *f* takes the place of *h*, while *h* takes the place of *s*. Thus, the seventeenth prefix of North-West Bantu Africa seems to have been originally *si*, which has become in some districts *hi*, and then again *fi*, *vi*. As all these permutations can be easily proved by comparative tables, why bother about distinguishing the exact pronunciation of the letter *t* (for example)? If it sounds to you more like *r*, then write it *r*, and have done with it. If it is very strongly aspirated, then write it *th*; if it hisses like an *s*, then don't be upset, but transcribe it *s* or *ts*.

But I humbly submit that the attempt to discriminate too nicely between what each separate individual writer-down of these languages thinks to be the *exact* type of the *t*, *k*, *b*, *r*, *l*, or *d* as he hears it uttered in the not very clear enunciation of the sometimes savage instructor, has only the result of wasting a great deal of the learner's time and patience on what is not really essential to the study of new languages.

H. H. Johnston.

AMERICA.

The Evolution of Modern Chile.

'Chile: its History and Development,' etc. By G. F. Scott Elliot. London: T. Fisher Unwin. 1907. Pp. xxviii. and 364. *Maps and Illustrations.* *Price* 10*s.* 6*d. net.*

No story of the evolution of a South American Republic can possibly lack the interest of perpetual movement. The history of Chile, presented to us by Mr. Scott Elliot in a most attractive and readable form, is full of the romance of early conquest and the later struggles for independence which have fashioned the Chilian people into a self-reliant and enterprising nationality. The pageant of history moves by with its constant succession of national heroes, from the truculent Spanish soldiers of fortune who were first beguiled by the promise of gold into southern explorations from Peru, to the military statesmen of modern days who fought with Chilian hearts and English names for the building up of Chilian nationality. Almagro and Valdivia, and all the rest of the reckless adventurers of early Spanish conquest (when the search for material wealth was conducted on other lines than those familiar to us at present), stand for a type of half-civilized exploration such as the world (happily, perhaps) is never likely to see again. O'Higgins and Cochrane belong to a later age of men who have lived and died for the salvation of Chile, and their names and their exploits are still kept fresh and green in the minds and memories of the rising generation of patriots. The author does only fair justice to the general national patriotism of the Chilian people, who, recruited from nearly every country in Europe, or descendants of a mixed race of Spanish and Araucanian origin, are all at one in their heartfelt loyalty to the Chilian flag. It may be, as he

says, the beauty of the country, or the infinite variety of its climate, that exercises an irresistible charm over the settler, but it is a fact that the Scotsman who sings "Auld Lang Syne" with tears in his eyes does not want to go back to bonnie Scotland, nor does the German of Southern Chile yearn greatly for his Kaiser and fatherland. Chile is a comparatively young country. Undivided loyalty to the flag may yet prove the great safeguard of its national existence. There are not people enough, so far, to admit of much division of national sentiment. There may be too many lawyers, and there certainly is far too much of politics, but there is no room for a split in the camp of universal patriotism. The book, being chiefly historical, does not leave much room for the material progress of the country and the status of its army or its fleet, but what there is of both forms a useful summary of the present position, both commercially and strategically. The nitrate industry is well illustrated, and well-deserved attention is called to the extraordinary development of sheep-farming in the south. This led to a burst of speculation in 1905, after the boundary settlement with the Argentine was achieved, which is just now being balanced by an inevitable reaction. The best prospects of Chile's future, however, lie far more in the gradual clearance of the forest tracts adjoining the southernmost extension of the railway system, and the promotion of agriculture and colonization south of Valdivia (the Araucanian country), than in pastoral enterprise of the comparatively restricted grass lands of Tierra del Fuego or the Andine slopes east of the snow-line. The rising interests of commerce in the Pacific will also offer new openings to Chilian enterprise. Chile is a growing country. The pageantry of war and revolution has, we hope, passed from her for ever, and a new vista opens before her. There may yet be a federation of the Spanish-speaking states of South America, which appears to some politicians to be the one thing necessary to relieve the vague but ever-perceptible shadow which creeps slowly southwards from beyond the equator. The difficulty will be the flag. If that difficulty can be solved, there would appear to be nothing to prevent South America from competing with North America for the material wealth of the world. Mr. Scott Elliot's book is well worth attentive study. It is always a matter of interest to inquire into the processes by which great nationalities are formed, and it is just this which is so excellently well told and so well illustrated.

Peru.

'Peru in 1906.' With a brief historical and geographical sketch by Alexander Garland, member of the Lima Geographical Society. Lima, 1907.

This is a folio volume in English, of 303 pages, prepared by order of Dr. Don José Pardo, the accomplished and enlightened President of Peru. Mr. Garland's well-written historical and geographical chapters also include very full information respecting the educational system and the institutions of the capital. The fourth section contains chapters on the agriculture, mining, manufactures, trade, and means of communication, on the currency, banking, finances, and the press. It is quite a model for what such a report should be, and is well illustrated with portraits, views, and maps.

GENERAL.

François Coillard.

'Coillard of the Zambesi. The Lives of François and Christina Coillard, of the Paris Missionary Society, in South and Central Africa (1858–1904).' By C. W. Mackintosh. *Frontispiece, Map, and 77 Illustrations.* London: T. Fisher Unwin. 1907. *Price 15s. net.*

In the ranks of the great missionary pioneers in Africa, François Coillard occupies a position midway between that of Robert Moffat and David Livingstone.

Unlike Moffat, his life-work was not confined to one region, and, unlike Livingstone, he never merged the missionary in the explorer. His direct contributions to geographical knowledge were not very extensive, neither is his biographer concerned to set them forth; Coillard's own book, 'Sur le Haut Zambèze' (English translation by the author of this biography, 'On the Threshold of Central Africa'), contains more information on that subject than the volume under review. Nevertheless, the life-story of a man who did much to give the map of South Central Africa its present political configuration cannot fail to appeal to other than purely missionary circles. Coillard was born in Asnières-les-Bourges, Berry, in 1834, of a French Protestant family, and went first to Africa in 1857 as a missionary of the Société des Missions de Paris. From that date until 1866 he was at work in Basutoland, and after an interval of two years, spent chiefly in Natal, he returned to Basutoland, where he continued his work of evangelization and civilization until 1877. In that year he led an expedition (promoted by Basuto Christians, who desired to start a mission on their own account) across the Limpopo through Banyailand, was taken captive to Lobengula's kraal, and by the Matabele sent to Bechuanaland. Thence, in 1878, he journeyed to the Zambezi, and in 1884 he founded the Barotseland mission. In Barotseland he spent the rest of his life, and there he died in May, 1904. In his forty-seven years' work he had but two furloughs in Europe, each lasting two years. In 1861 he was married at Capetown to Miss Christina Mackintosh, a lady of pure Highland blood, who, from that to the day of her death in 1891, shared all the joys and hardships of his journeys. Madame Coillard and a young niece who accompanied her were the first white women to see the Victoria Falls. In his Banyailand expedition, and in various journeys in the upper Zambezi valley, Coillard broke new ground, while his investigations into the manners and customs of the Basuto and Barotse tribes yielded rich material to the ethnologist. The great influence which he acquired with Lewanika and the Barotse in general was invariably used for the promotion of good government; it may be said without exaggeration that Barotseland as we know it to-day is the work of his hand. To his statesmanlike advice is due the fact that that country was added to the British Empire without the firing of a shot, and it is also largely due to his wise counsel that the Barotse have remained peaceful ever since.

Coillard throughout his life put his spiritual work first; the spread of Christianity was his absorbing passion, and it is rightly enough that side of his work which Miss Mackintosh emphasizes. Her narrative, brimful of excellent stories and pertinent comment on political questions, has at times a piquantly ironical strain. It is a fitting memoir of a noble, an heroic figure. A word in praise of the photographs should be added. They illuminate the text.

F. R. C.

SHORT NOTICES.

Europe.—'The Shaping of Lindsey by the Trent.' By F. M. Burton. (London: Brown & Sons. 1907. Pp. xi., 59. *Diagrams and Illustrations.*) This study of a characteristic district of England traces its condition through various periods. The writer shows how it is possible to distinguish four different islands in succession —those of the chalk, the oolites and the Keuper, and the more recent isle of Axholme; and how the Trent, during the first two periods flowing in its old course during which it carved the "gap" at Lincoln, but subsequently captured by the Humber, had the strongest influence on their formation and shape.

'The Bernese Oberland.' Vol. 3. By H. Dübi. (No. 11 of Conway and Coolidge's Climbers' Guides. London: Fisher Unwin. 1907. Pp. xxiv., 19[illegible] This work, conveniently produced in the form of a note-book, with pencil a[illegible]

sheets for memoranda, gives the necessary information as to club-huts, routes, etc., in connection with the sport to which it is a guide. But as it gives elevations in metres and feet of every elevation within the area treated, and careful references to authoritative maps, it would form a useful source for the close study of the region.

'A Book of the Cevennes.' By S. Baring Gould. (London: John Long. 1907. Pp. x., 308. *Map and Illustrations.*) This is a typically fascinating account of a few of the many points of interest in the curiously little-known country to the west of the Rhone. Clear description, geological and historical notes are welded into a readable whole by touches of personal narrative. There are many beautiful illustrations, though the map is a poor thing, and insists upon the Gulf of "Lyons."

'Climatotherapy and Balneotherapy.' By Sir Herman Weber and F. Parkes Weber. (London: Smith, Elder. 1907. Pp. 833.) Although this large volume deals with North African as well as European health resorts from the point of view of climate and mineral waters, it may be classified as European, as it is a third edition of 'The Spas and Mineral Waters of Europe,' considerably enlarged, under the editorship of Dr. F. Parkes Weber. Not only are there descriptions of a vast number of resorts, with the necessary details concerning each, but a treatise on climatology from the point of view of health, while a number of other general chapters, a bibliography, and other features attest the complete and authoritative character of the work.

'The Netherworld of Mendip.' By Ernest A. Baker and Herbert E. Balch. (Clifton: J. Baker. 1907. Pp. xii. and 172.' *Plans and Illustrations.*) Speleology must be a study of peculiar fascination, combining as it does a true sport and a true science, and pervaded as its pursuit is by mystery. To all whom these attributes attract, this must be an entrancing volume, and it will become a classic in the study of British caves. For the attention of the authors is given, not only to the caves of Mendip, but, in a few of the later chapters, to caves in Derbyshire, Yorkshire, and Wales, and to the Mitchelstown caverns in Ireland. The narrative of their arduous journeys provides entertaining reading, and beyond this, the book gives evidence of the valuable new work they have done and are doing in a still almost virgin field of geography and geology.

'Ball's Alpine Guide, Part I. The Central Alps.' (London: Longmans. 1907. Pp. xxviii. and 327. *Maps.*) This guide, bearing the honoured name of John Ball, is of course a re-issue. The new edition has been "reconstructed and revised on behalf of the Alpine Club" under the editorship of Mr. A. V. Valentine-Richards, who has been assisted by a band of competent contributors selected from among the club's members. It appears to be all that a technical guide should be; of great value, not to mountaineers only, but to all intelligent visitors to the Alpine region. The maps, which bear the imprint of Ludwig Ravenstein of Frankfort-on-Main, are with one exception on the solid-colour contour principle, and are among the best German work on this system we have seen.

'Venice on Foot.' By Hugh A. Douglas. (London: Methuen. 1907. Pp. ix. and 422. *Maps and Illustrations.*) It is certainly not easy to walk in Venice without some guide, but this book should make it so, for directions are very carefully given. Very close details are given with regard to buildings—sometimes rather baldly, so that one is tempted to wish that the space occupied had been otherwise utilized, although it is true that by no other means could completeness be attained in so small a compass, for almost every house in Venice has its history.

'Cook's Handbook to Norway and Denmark, with Iceland and Spitzbergen.' (6th edition. London: Thomas Cook. 1907. Pp. 304. *Maps.*) Although this is a well-arranged and useful guide, it still, in its new issue, exhibits certain

minor inaccuracies, which, however, appear to be mainly printers' slips. On some of the outlying districts, and on Iceland, the information, from the tourist's point of view, reads as somewhat immature, but on the familiar parts it appears sound.

Asia.—'Across Persia.' By E. Crawshay Williams. (London: Edward Arnold. 1807. Pp. xii. and 348. *Maps and Illustrations.*) This is a thoroughly entertaining travel-narrative, which leaves vivid impressions of the Persian and the scenery of his country on the mind of the reader. Mr. Williams travelled from Bushire by Shiraz, Isfahan, Kashan, and Tehran to the Caspian coast, so his book is rightly titled. It is also notable for perhaps the most astonishing index-entry ever conceived. "Author, the," it begins, "arrives in Persia," and continues with practically an analysis of the whole book in three columns.

'Murray's Handbook for Japan.' (8th edition. London: John Murray. 1907. Pp. x. and 570. *Maps.*) This deservedly well-known guide has obviously been much improved in many respects. The introduction is admirably clear and concise. Special notice is merited by the maps, which bear the imprint of the Toyodo Engraving Office, Tokyo. Some of the detailed maps of small areas are beautiful work, and an interesting rainfall-map is included by permission of the Meteorological Observatory at Tokyo.

Africa.—'Murray's Handbook for Egypt and the Sudan.' (11th edition. London: Stanford. 1907. Pp. xiv., [170], 613. *Maps.*) A great deal of work has been carried out in the new edition of this guide, under the editorship of Mr. H. R. Hall—not only of revision of existing material, but of recasting and rewriting. The spelling of names has been brought more nearly within the bounds of convention—a desirable reform to a book of this character. The maps also have received careful attention.

'Two Dianas in Somaliland.' By Agnes Herbert. (London: John Lane. 1908 [*sic*]. Pp. 306. *Illustrations.*) This account of a shooting expedition by two ladies possesses the interest attaching to an unusual proceeding, and those parts which deal with the chase are entertaining; the general narrative in which they are wrapped up is less attractive.

'W. Holman Bentley, D.D.: The Life and Labours of a Congo Pioneer.' By his widow, H. M. Bentley. (London: Religious Tract Society. 1907. Pp. xx. and 440. *Map and Illustrations.*) The career of the eminent missionary is well told, and nothing is more remarkable than to see laid down on the map the scope of his work and that of his colleagues.

General.—'Peat: its Use and Manufacture.' By Philip R. Björling and Frederick T. Gissing. (London: Griffin. 1907. Pp. xii., 173. *Illustrations.*) This well-arranged handbook treats peat from the scientific and every economical point of view. Details are furnished as to the methods of working it for various purposes. There is a very full bibliography. In the first chapter the geographical distribution of peat is briefly but clearly summarized.

'Over-sea Britain.' By E. F. Knight. (London: Murray. 1907. Pp. ix. and 324. *Maps.*) We have here a fair general text-book—"a descriptive record of the geography, the historical, ethnological, and political development, and the economic resources of the Empire"—dealing with the British possessions in the Mediterranean, Africa, and America. A second volume is intended to cover the rest of the ground. Such works are by no means so numerous as to make another unwelcome. The topographical maps are, unfortunately, poor; ignoring relief, they fail to illustrate one of the most important features of the text. The latter is systematically arranged, and apparently well indexed.

THE MONTHLY RECORD.

EUROPE.

Colonization of Newly-formed Land by Plants.—This is a subject which is being studied in various quarters at the present day, and the results are likely to be of great interest from the point of view of plant geography. An unusual opportunity for such a study has been supplied by Lake Hielmar, in southern Sweden, the level of which has, since 1882, been lowered by over 6 feet, with the result that not only have considerable areas been laid bare round its shores, but a large number of new islands have risen above its surface. The new growth of vegetation on these was examined by botanists in 1886 and 1892, and has lately been carefully studied on the spot by Mr. Selim Birger, who has been able to bring out some interesting points by comparing his results with those of his predecessors. His observations were published at length in the *Archiv für Botanik* for 1905, but have since been made more generally available by a short summary given in *Engler's Botanischen Jahrbüchern* (vol. **38**, Heft 3). Altogether twenty-nine islands have been formed, some at a considerable distance from any old land, but only sixteen attain any great size, though twenty reach a height above the water of 2½ feet and upwards. The observations are mainly concerned with phanerogams and vascular cryptogams, but the occurrence of some mosses and lichens was also noted. The progressive colonization of the islands is shown by the number of species recorded by the three different observers. Thus in 1886 (four years from the first lowering of the level), 113 vascular plants were noted; in 1892, 184; and in 1904, 202; and this in spite of the eventual disappearance of some of the earlier arrivals. It is an interesting fact that in the case of islands which have merely received an extension of area, the newly-formed portions seem to have supplied access for new species, even to the older portions. Mr. Birger distinguishes between casual and constant or regular modes of dispersal, and shows that the latter is far the more important, as is proved by the wide diffusion over the islands of individual species. Of the factors of dispersal, the water is by far the most effective. At times of high water, seeds or portions of plants are carried to portions of the islands which are dry at other times, and on the retreat of the water are retained by the existing vegetation as by a sieve. Parallel lines of such *débris* are often formed, and on one of the islands the writer found thirteen specimens of *Picea excelsa* (Norway spruce) growing in a line on a bank so formed. The prevailing wind being from west to east, the current sets in the same direction, and the new arrivals establish themselves first on the west side of the islands. The part played by the wind directly is of secondary importance, for on the newly formed islands there is nothing to retain objects brought by this means. Birds and man are both instrumental in introducing plants, the former in part through the material used for their nests. The height of the islands above the water is important in determining the rapidity of the process of settlement, some of the higher islands having gained over seventy species in twenty-two years. After ten years plant formations already show signs of development, a series of zones succeeding each other from the shore to the centre of the islands. Young forest is already growing up towards the middle of the islands, the most common species being *Betula verrucosa*, *Populus tremula*, *Alnus glutinosa*, and *Salix caprea*, though fourteen different species in all are represented, including *Pinus sylvestris* and *Picea excelsa*. The trees, some of which have already reached a considerable height, show signs of spreading at the expense of the other formations, which is a reason of the dying out of certain species which had obtained a footing.

Changes on the Baltic Coast of Schleswig.—A careful study of the recent osses and gains on the east coast of Schleswig, especially during the period between 1795 and 1875, has been made by Dr. G. Wegemann, who summarizes the results in *Petermanns Mitteilungen*, Nos. 9 and 10, 1907, giving also a map on which the position and extent of the losses and gains are clearly laid down. The reason for not bringing down the comparison later than 1875 is that this was the date of the last cadastral survey of this region, and that no trustworthy observations of more recent changes are available. The basis of comparison at the earlier date is supplied by the cadastral survey of northern Schleswig carried out between 1788 and 1800, records of which are for the most part preserved. The accuracy of this earlier survey varies greatly in different parts of the area, and it is only in the case of Kjelstrup and Wilstrup that modern requirements can be said to have been fulfilled. It is, therefore, unsafe to trust to the accuracy of the results obtained by a comparison of the areas given by the two surveys without closer inspection, but Dr. Wegemann thinks that where the error of the old survey does not exceed about 0·5 per cent., we may admit differences of area of 100 square miles and over in the case of units which do not exceed 1 hectare, though for larger units the difference obtained by comparison of the two surveys must be proportionately greater to be accepted as trustworthy. Dr. Wegemann says that current ideas as to the conditions and causes of changes on the German coasts are in many ways erroneous. Thus it is a mistake to suppose that the land normally gains in area, and that loss is confined to exceptional periods of storm. It is necessary to take into consideration the differences in geological structure and geographical position between different parts of the same coast, for these play an important part in determining whether the coast-line is advancing or receding. Portions which are favourably placed on the whole may suffer from an exceptional storm, but rarely show a continual loss. The high portions of the coast (known locally as *klint*) are worn away both by atmospheric agencies and by the direct action of the waves, the latter coming into play almost exclusively during storms, and being most effectual where there is a wide sea-area in which to develop their force. While the exposed headlands are thus eaten away, the bays and inlets are filled up by the eroded material. Dr. Wegemann treats in detail of the coasts in question, describing the geological structure of the separate portions, and tracing the amount of loss and gain in each special case. His map brings out clearly the influence of exposure to waves, currents, etc., in determining the portions specially subject to loss, though it is not quite evident whether the currents shown by means of arrows actually exist, or are merely such as would give rise to the observed conditions.

ASIA.

Climbing in Sikkim.—The Indian newspapers contain an account of an attack on Kabru (24,015 feet) made on October 20 last by two Norwegian climbers, Messrs. Rubenson and Monrad-Aas, in which the summit ridge between the two peaks was reached at a point about 23,900 feet. The mountain was approached from the south-west by the Rathong valley and glacier. Snow and ice were met at 18,000 feet. At 19,500 feet a camp was formed under "the Dome" of Freshfield's map. At this point an ice-fall was encountered which was only rendered passable for coolies after five days of hard work with ice-axes. A camp was formed 21,500 feet above sea-level, on the upper snow-slopes visible from Darjiling under the crest of Kabru; but this not proving high enough, a tent was moved up to 22,000 feet, where with two coolies the travellers passed the night; temperature - 29° Centigrade. Leaving the coolies in camp, the Norwegians started at 8.30 a.m. An icy wind impeded their progress and forced them towards the lower or north-east peak. The

climbing was fairly arduous, steps having frequently to be cut, so that it was not till 6 p.m. that they reached what had appeared to be the summit. They found a snow-ridge some 60 feet higher beyond, to which they had not time to go on. Descending in the dark, one of the party slipped, but was held by his companion, and they regained camp in safety by moonlight. Mr. Monrad-Aas was somewhat severely frostbitten. Neither of the climbers suffered seriously from mountain sickness. They speak in warm terms of the behaviour of their coolies, in whose management they seem to have been exceptionally successful. We hope at a future date to give full details of this interesting exploit. The climbers' route can be followed in detail on Signor Sella's photographs. It does not coincide, except perhaps in the last climb, with that described by Mr. W. W. Graham, who approached the mountain from Alukthang, at its south-east base.

Heights of Himalayan Peaks.—It is generally recognized that the heights obtained by the Trigonometrical Survey for the culminating summits of the Himalayas, by observations from distant stations, cannot be trusted to be minutely accurate by reason of the varying effects of refraction which came into play. The extent to which uncertainty may be due to this cause when only long-distance rays are available is shown by Colonel Burrard in the *Annual Report of the Board of Scientific Advice for India* for 1905–06 (Calcutta, 1907), in the section dealing with geodesy. As is well known, the coefficient of refraction to be used in correcting the observed heights differs according to the altitude of the point of observation, but we are still ignorant of the exact scale of such variation. In calculating the height of Kinchinjunga, Sir Andrew Waugh used a coefficient of 0·077, while in the case of K_2 Colonel Montgomery used one of 0·047, the observations in the former case having been taken from the plains of India, whereas in the latter they were taken from altitudes of 15,000 and 17,000 feet. But though there is no doubt that the coefficient used should be smaller for K_2 than for Kinchinjunga, we cannot yet say whether the above difference was or was not too great. If the coefficient were the same in the two cases (whatever its amount), Kinchinjunga would be the higher of the two peaks, so that it cannot be said with certainty that K_2 is the higher, as is indicated by the figures adopted by the Survey. Again, the height of Mount Everest, as given by the mean of six observations from the plains, is 29,002 feet (the range of variation in the individual results being only 36 feet). But when observed from the Darjiling hills, the mean, as deduced from six observations, becomes 29,141 feet, the coefficient of refraction being assumed as 0·05, instead of 0·07, as in the former case. Here again the range of variation is very small—only 17 feet. Colonel Burrard uses an ingenious method of testing the relative suitability of the possible coefficients of refraction in the case of certain peaks. Thus for Nanga Parbat he has calculated the range of variation in the values obtained from eleven different stations, according as the coefficient employed varies from 0·04 to 0·10, and finds that such range is smallest (125 feet) for the value 0·05, while for the value 0·10 it amounts to as much as 1028 feet. The mean obtained for the height of Nanga Parbat, with the coefficient 0·05, is 26,676 feet, or very near that adopted by Montgomery (26,620 feet), which results from the adoption of a general coefficient of 0·057. By a similar method Colonel Burrard finds that the accepted height of Dhaulagiri (26,795 feet) is probably too low. This method must not, of course, be trusted too far, as we are not justified in assuming the same coefficient to be applicable to each observing station. It is proposed to persevere with the observations, as better results may be expected from a long-continued series.

Kozloff's New Expedition.—Our Hon. Corresponding Member, Colonel J. de Shokalsky, sends us some details regarding the new expedition to Central Asia organized by the Imperial Russian Geographical Society, which was just starting

when he wrote. It is, like the last, under the command of the experienced traveller Colonel P. Kozloff, well known for the part which he took in the expeditions of Prjevalsky, Petzoff, and Roborovsky, and for his own great journey in Eastern Tibet as commander of the last expedition sent by the society. The new expedition has as its object the exploration of Southern Mongolia, the district of Kuku-nor and western slopes of Nan-Shan. Kiakhta is chosen as the starting-point. Thence the expedition will travel to Urga and to Din-yuan-in, crossing the Gobi by a route somewhat to the east of that of the last expedition in 1899–1901, and making some small digressions in order to explore the chain of Bet-khara-narin-ula. At Din-yuan-in the base of the expedition will be established, and a regular meteorological station arranged for a year. From this point a journey will be made to the Gon-ju, the land of Badang-Jareng, and thence southward through the Nan-Shan chain to lake Kuku-nor. Other journeys will be undertaken from the base in the direction of the Alashan range and Ordos. The great basin of Kuku-nor will be explored as completely as possible, and for this purpose the expedition is supplied with thermometers, sounding-machines, and other instruments. It also possesses a small boat. From Kuku-nor the expedition will proceed by way of Lan-chou-fu to Din-yuan-in, and thence north in the direction of the Russian frontier. It will probably occupy one and a half or two years. A young geologist of the University of Moscow is attached to the expedition, which consists in all of some twelve or fourteen members.

AFRICA.

The Volcano of Alid, Eritrea.—As in other parts of East Africa, the great trench or rift-valley which skirts the eastern edge of the Abyssinian plateau is marked by the evidences of volcanic activity, some of it persisting to the present day. Almost at the northern extremity of the zone of depression occurs the volcano of Alid, which, though known of vaguely for some years, has only lately been examined with any care by the Italians. An ascent of the volcano was made early in 1906 by Profs. Dainelli and Marinelli, who describe its physical features and relations with the surrounding country (which shows other traces of volcanic action) in the *Rivista Geografica Italiana*, June and July, 1907. The mountain, which reaches an altitude of 910 metres (2985 feet), and blocks a great part of the trough from which it rises, lacks the conical characteristic of volcanoes, its principal crest forming an elongated ring, within which a well-marked furrow runs from south-west to north-east, or at right angles to the direction of the trough. Within this ring, towards the western end of the enclosed space, is a great crater, over half a mile in diameter, with walls of some 350 feet in height. The Italian official map is incorrect in marking a second crater further east. Fumaroles occur both inside the crater and elsewhere on the mountain, but the vapours which escape are almost entirely wanting in the chlorine compounds which are so abundant in the case of the Italian volcanoes. The outer slopes descend somewhat abruptly to the base, which is of small relative extent, this peculiarity in the contour being, perhaps, due to the small amount of precipitation in this region. To the north and to the south a vast lava-plain extends, and from its surface a large number of small cones and craterlets rise, which seem to be arranged more or less in lines, but have no apparent relation to the main volcano. The writers think that they are the outcome of a later period of volcanic activity, and that the lava which forms the plain has been derived from these vents rather than from the main volcano. They were not able to study the geological structure of the latter with any minuteness, but think that its base is in part composed of crystalline rocks, though trachitic and basaltic materials seem to form a larger part of it.

In the November number of the same journal Captain Tancredi reports an eruption, in June, 1907, of the peak of Afdera, on the Abyssinian side of the frontier in about 13° 15′ N.

The New Franco-Liberian Frontier, negotiated between the President of Liberia (on his recent visit to Europe) and the French Government, will run as follows: "Starting from the point on the frontier of the British colony of Sierra Leone where the river Moa or Makona crosses that frontier, the Franco-Liberian frontier shall follow the left bank of the river Makona up-stream to a point 5 kilo-

metres to the south of the town of Bofosso. From this point the frontier shall leave the line of the Makona and be carried in a south-easterly direction to the source of the most north-westerly affluent of the Nuon river or Western Cavalla. This line shall be so drawn as to leave on the French side of the boundary the following towns: Kutumai, Kisi Kurumai, Sundibú, Zuapa, Nzibila, Koiama, Bangwedu, and Lola. From the north-westernmost source of the Nuon, the boundary shall follow the right bank of the said Nuon river down-stream to its presumed confluence with

the Cavalla, and thenceforward the right bank of the river Cavalla down to the sea. If the ultimate destination of the Nuon is not the Cavalla river, then the boundary shall follow the right bank of the Nuon down-stream as far as the town of Tuleplan. A line shall then be drawn from the southern outskirts of the town of Tuleplan due east to the Cavalla river, and thence shall follow the right bank of the Cavalla river to the sea." It has been generally assumed that the Nuon flows into the Cavalla, and in any case, it flows in the lower part of its course very near to the north-westernmost bend of that river; but it is now believed to be the upper St. John's river (see below). Tuleplan is in about lat. 6° 50′. The river Makona takes a much more northerly course than has hitherto been estimated. The river Nuon is also situated 20 or 30 miles further to the east than it is put on English maps, and the Cavalla also takes a more eastern course. Consequently, the territory of Liberia as thus demarcated is rather larger than it would appear on the uncorrected English maps at the present date, many of the recent French surveys not having been published. The accompanying sketch-map shows provisionally the course of the frontier, which cannot be laid down exactly until surveyed on the spot. The Franco-Liberian Delimitation Commission is starting work very shortly (during the coming dry season). The principal Liberian representative will be a distinguished Dutch surveyor and explorer, who will be assisted by an officer of the Dutch navy. He will probably be accompanied by one or two Liberian colleagues already trained to geographical work. It may be mentioned, in this connection, that the correct spelling of the name of the river which bounds Liberia on the east is *Cavalla*, not Cavally. This last form has only recently come into use by an American corruption of the older form. *Cavalla* was a name applied to the river by the Portuguese in 1480 (approximately), and it means "Horse mackerel." This fish swarms in certain seasons at the Cavalla bar.

Surveys in Liberia.—With reference to the question of the Liberian frontier above referred to, we have been informed that the recent surveys of Messrs. Parkinson and Owen and of Messrs. Byrde and Leighton, in the service of the Liberian Development Chartered Company, have considerably altered the inner geography of that land. (Mr. S. Owen was trained under Mr. Reeves of the Royal Geographical Society before going to Liberia.) According to Messrs. Parkinson and Owen, the main stream of the St. Paul's river comes much more from the east than was supposed. According to Mr. Byrde, the Nuon river is really the upper St. John's, which enters the sea at Grand Bisa; while according to Mr. Leighton, the upper Cavalla does not take such a considerable bend to the west as had been conjectured by the French explorers.

The Nigeria-Kamerun Boundary.—The delimitation of the southern section of this boundary, from Yola to the Cross river, one of the last West African boundaries to be taken in hand, is now being carried out by a mixed commission under Major Whitlock (on the British side) and Captain Häring (representing Germany). The commissioners met at Nassarawa in September, 1907, and work was at once commenced. As the work of delimitation on the northern frontier of Nigeria has also been in progress for some time, the whole of the boundaries of the territory will soon be definitely fixed.

Captain Lenfant's Expedition to the Southern Shari Basin.—Further particulars of the work accomplished by this expedition (*Journal*, vol. **30**, p. 440) are given in the November number of *La Géographie*, accompanied by a sketch-map showing the network of routes traversed by the various sections of the expedition. The area covered by them extends from Forth Archambault on the Shari, in the north-east, to Carnot on the south-west, between which extreme points a belt of country varying from 100 to 200 miles in width has been examined with

unusual thoroughness. All the main outlines of the hydrography have been brought to light, and the importance, in the Shari system, of the Wam, or Wom, has been fully established. It forms the upper course of the Bahr Sara, as was virtually proved some years ago by the expedition of M. Bernard (*Journal*, vol. 17, p. 306). This traveller suggested that the Bahr Sara (the existence of which M. Maistre was the first to bring to light), might be considered the main headstream of the Shari, and this is borne out by the measurements at the confluence carried out by members of Captain Lenfant's expedition, which showed that the volume of the Bahr Sara was, at the time of measurement, more than twice that of the eastern headstream. The Wam-Bahr Sara is now known from its source to its mouth, and its main tributaries have also been mapped. Whilst its lower course, to a little above the confluence of the Fafa (right bank) is navigable, the upper course is so obstructed by rapids as to be quite impracticable. The discovery of the Pende, one of the two principal headstreams of the Logone (the other being the Mambere), has already been recorded in the *Journal*, as well as the opinion of Captain Lenfant that it will supply the best route from Carnot to Lake Chad. During the prosecution of the work of the expedition, one of the parties met with some difficulties through the hostility of the Mbakas, a race of cannibals, who kept up their attacks for a week, but otherwise peace seems to have been maintained with the natives.

Nyasaland.—By an Order in Council of July 6 last, published in the *London Gazette* for September 3, the British territory hitherto known as the British Central Africa Protectorate will in future be styled the Nyasaland Protectorate. The title of the Commissioner is also changed to that of Governor, whilst executive and legislative councils are established. Sir Alfred Sharpe has been appointed the first governor.

AMERICA.

Mining in British Columbia.—From the official report of the mining operations in British Columbia for the year ending December 31, 1906, it appears that the total production for that year amounted to the value of $24,930,546, 11·2 per cent. over that of 1905, 31·6 per cent. over that of 1904, and 42·8 per cent. over that of 1903. To the total production of 1906, copper contributed $8,288,565; gold (placer and lode) $5,579,039; coal, $4,551,909. British Columbia's production of copper in 1906 far exceeded that of all the rest of the Dominion, which amounted to but $2,318,095. Much more still did its gold production exceed that of all the rest of the Dominion, except Yukon territory, which slightly exceeds it. Its lead production, again, amounted to nearly twenty-four times that of the rest of the Dominion. Its coal production for 1906—nearly two-seventh of that of the Dominion—is the highest on record for any year, exceeding that of 1905 by the value of $398,973. The total mining production for all years up to and including 1906 amounts to $273,643,722, gold standing first, and coal and coke second. The collieries of British Columbia are at present, and expect to continue for some time to come, pressed by more orders than they can answer, a stringency attributed chiefly to scarcity of labour. The only coalfields actually producing coal are the Vancouver island coalfield, on the east coast of Vancouver island, and the Crow's Nest pass coalfield in the extreme south-east of the province, on the west slope of the main range of the Rocky mountains. The gross amount of coal mined in the Province in 1906 was 1,899,076 tons, or 73,244 tons more than that of 1905. Some 381,773 tons of this coal were manufactured into coke, of which there were produced 199,227 tons. Of this output of coal and coke, 681,889 tons of coal were sold for consumption in Canada, and 679,829 tons for export to the United States. Though

not yet producing coal in the commercial sense, properties in the Nicola valley are being opened up systematically since the completion of the railway from Spence's Bridge to the Nicola coalfield. A seam of coal 6 to 8 feet thick has been opened up by the Nicola Valley Coal and Coke Co., and it is expected that the property will be shipping coal in 1907. The Pacific Coal Co. at Hosmer, on the Pacific railway, has also begun active operations. The Report, including special district reports, is illustrated by diagrams, plans, and plates, a map of Columbia, and a geological map of Graham island.

The International Boundary West of Lake Superior.—In a communication to *Science* for July 19 last, Mr. H. N. Winchell calls attention to some early maps of the region between Lake Superior and the Lake of the Woods, as showing that the international boundary as finally drawn in 1842 gave to Canada a considerable area (some 2500 square miles), which would have formed part of the United States had the intentions of the negotiators of the original treaty of 1783 been adhered to. As is well known, the eventual and existing boundary follows an arbitrary and unnatural direction in crossing the Lake of the Woods, in order to pass through what was accepted in 1842 as the north-west angle of the lake, and it is commonly held, in this country at least, that Canada was the loser to a small extent by this deviation of the frontier from a common-sense line. But Mr. Winchell points out that there were two or more distinct water-routes from Lake Superior to the Lake of the Woods, and he holds that the intention in 1782-3 was that the most northerly of these should be followed, and that the line should be carried, not to the point eventually agreed upon as the north-west angle of the Lake of the Woods, but farther north, to its outlet at Rat portage, as shown in an English map published by Laurie and Whittle in 1794. The acceptance of the more southerly line he attributes to the inadvertence of the American Commissioners in 1842. It may be remarked, however, that, whatever was the intention of the treaty of 1783, there was an obvious fairness in carrying the line farther south, inasmuch as the outlet of the Lake of the Woods was supposed at the time to lie farther south than subsequently proved to be the case. And it is by no means certain that Mr. Winchell's contention is correct, for it is not borne out by the map in Kitchen's atlas, which laid down the boundary-line in the very year of the original treaty.

The Discovery of San Francisco Bay is the subject of a careful monograph (San Francisco, 1907) by Dr. George Davidson. Ransacking all available sources, the monograph brings to bear on the documentary evidence, obscured in many parts through alteration of local nomenclature, inadequate description, and inaccurate determinations of latitude, the searchlight of familiarity with the coast-line traversed —its every cliff, islet, rock, and headland, its forest, timber patches, and old Indian trails—a familiarity acquired by forty-five years' geodetic and geographical work on the seaboard. The monograph includes a history of Spain's heroic efforts to reconnoitre the coast from Cape San Lucas northwards, and comprises passages, not only of geographical, but also of human interest. The following are events in the earlier history of the north-western seaboard exploration: Cortes delineated the east and west shores of the Mare Californiæ, but by 1536 the exploration of the Pacific had reached no higher than Cape San Lucas. In 1539 Ulloa reached Cabo del Engano, in 29° 56′ N. On September 28, 1542, an expedition under Cabrillo discovered San Miguel, now San Diego, bay. Driven off Point Conception, the expedition anchored on the north shore of San Miguel, the westernmost of the Santa Barbara islands, at a port called by them Port Possession. On November 14 they sighted the mountain massif (2200 feet) overhanging Fort Ross (38° 31′ N.), but advanced no farther. This landfall, 75 miles north-west

of the Golden Gate, they named El Cabo de Pinos. Probably they also saw King Peake, in 40° 9′. On their retreat they discovered (November 16) the gulf of the Farallones, just missing the Golden Gate. This gulf, measuring 1200 square miles, they called "Bahia de los Pinos." Cabrillo and Ferrer, his pilot, were thus the first Europeans to see the hills of San Francisco and the islands of the two groups of the Farallones. Making another attempt northwards, in 1643, the vessels reached Fort Ross, and probably saw as far north as Point Arena, in 38° 57′. On January 17, 1579, Drake sheltered in Drake's bay, east of Point Reyes, taking possession of the country, which he named New Albion. Under the stimulus of Drake's and Cavendish's exploits, Carmeño, commanding the galleon *San Augustin*, made (end of 1595) the latitude of Point Reyes, but, driven ashore, the vessel was totally wrecked. Next, Vizcaino reported the discovery (December 16, 1602), of a port in 37° N., to which he had given the name Monterey. Vizcaino's thirty-two reconnaissance-sketches, hidden for two hundred years, were exhumed in 1802. They give no sign of the Golden Gate. Bolinas point, however, is named after Vizcaino's pilot. Then, after Spanish exploration had been suspended for 165 years, the Portola land expedition of 1769, not finding Vizcaino's "famous port" in 37°, discovered the south-eastern part of the Bay of San Francisco, but not the Golden Gate, which was first sighted by the Fages Expedition of 1772. Prof. Davidson traces the early stages of settlement on the site of San Francisco.

AUSTRALASIA AND PACIFIC ISLANDS.

The Highest Summit of Tasmania.—The highest point in the Ben Lomond range, in north-eastern Tasmania, has hitherto been supposed to be a station of the Trigonometrical Survey at the southern end of the range, the height of which was fixed by the Survey as 5010 feet. It is possible, however, that a point near the northern end, not fixed by the survey, may be still higher; and some provisional observations with a view to settle the point have been made, at the instance of Colonel Legge, by Messrs. Giblin and Piesse, who submitted the results to a meeting of the Royal Society of Tasmania on June 11, 1907. The observations, made in 1906 and 1907, are not such as to give a final result, being made by aneroid, controlled by a rough measurement with an Abney level. But as the observations were several times repeated, care being taken on each occasion to use the mean of ascending and descending readings of the aneroid, and to make allowance for the barometrical conditions at the same time, the probability seems to be that the result is fairly accurate, especially as the observation with the Abney level confirmed the determination by the aneroid, the height given in each case lying between 5100 and 5200 feet. The northern summit of the range (for which the name Legge's Tor is proposed by the authors of the paper) may thus be the culminating summit of Tasmania, Cradle mountain, the height of which is stated on the maps to be 5069 feet, being in this case the second highest. Messrs. Giblin and Piesse hope to settle the point by triangulation during the present year.

GENERAL.

Geographical Boundaries.—A thoughtful and suggestive paper under this title, contributed by Miss E. C. Semple to the *Bulletin of the American Geographical Society* for July and August last, forms an interesting complement to Lord Curzon's lecture on frontiers, referred to in the December number of the *Journal*. While the latter was largely concerned with modern political frontiers and the more or less artificial conditions governing them, Miss Semple applied herself rather to the natural laws which determine the evolution of boundaries in the earlier stages of

human society. The paper forms but a chapter of a more elaborate work on the 'Influences of Geographic Environment,' the appearance of which the author's special competence to deal with such a subject leads us to anticipate with much interest. The key-note of the present chapter is the zone-like, fluctuating character of natural boundaries as opposed to the hard-and-fast lines which may eventually be developed from them or arbitrarily laid down by political agreements. This same character is to be traced in geographical boundaries of all kinds, whether marking the distribution of natural phenomena—such as forest or prairie, perpetual snow, and the like—or concerned with the mutual relations of mankind. "The habitable area of the Earth everywhere shows its boundaries to be peripheral zones of varying width, now occupied and now deserted, protruding or receding according to external conditions of climate and soil, and subject to seasonal change." The boundaries of race and state which are subject to greatest fluctuations are those which are determined by the resistance of other peoples, anything which increases the expanding force of the one being registered in an advance of its boundary and a retrusion of that of its neighbour. The more aggressive people throws out long streamers across the debatable zone, and its advance is helped on by the formation of ethnic islands beyond the base line of continuous settlement. Narrow straight boundaries point to an equilibrium of forces, and are found in old, thickly populated countries, while the wide, ragged border zone belongs to new and especially to colonial peoples, being most irregular where a superior intrudes upon an inferior people. The tendency to excessive expansion by following lines of least resistance is especially characteristic of primitive and nascent peoples, and natural boundaries which set bounds to this expansion, such as mountain, sea, or desert, are of far greater importance for such peoples than for more fully developed ones. All natural features which serve to check or retard expansion tend to become racial or political boundaries, and all present a zone-like character, a frontier wilderness being again and again found to separate neighbouring peoples, sometimes as a result of formal agreement. Such border wastes are sometimes, however, occupied by alien races, whether too insignificant to arouse the desire of conquest, or powerful enough to take advantage of the favourable conditions of life sometimes offered. Even when the nicely determined political boundary has been evolved out of the wide waste zone, it is still encased in a zone of contact wherein are mingled the elements (especially the ethnic ones) of either side; and such a border zone of assimilation has a particular significance as preparing the way for the advance of the state boundary from either side. The influence of a border situation in various other directions (such, *e.g.*, as in that of favouring political autonomy) is also traced, and a wealth of illustration supplied from actual instances, for which, however, reference must be made to the original article.

An Undescribed Map of Visconte Maggiolo.—Among the many little known maps that have been brought to light of late years, especially in the Italian libraries, is one of Visconte Maggiolo now in the Biblioteca Federiciana at Fano, to which it was presented by its former owner, Cav. Luigi Masetti, in 1862, but which had not become generally known to students until the present year. It has now been described in the November number of the *Bolletino* of the Italian Geographical Society by Prof. S. Crinò, a well-known student of the history of cartography. The map embraces the whole of the world as known in the early part of the sixteenth century, and bears the legend: "Ego Vesconte de Majollo compoxui anc cartam de anno dni 154 (*sic*), de viii. juni in civitatem Janua." It is drawn on parchment, and measures 4½ feet in length, the scale working out as just 1: 20,000,000. Prof. Crinò says that the map shows a good knowledge of the results of the new discoveries, and he specially praises the portrayal of Africa and the new

world, though he is hardly happy in his reference to the delineation of the Nile and the mountains of the Moon (evidently after the Ptolemaic model) as an instance of the up-to-date character of the map. As a rule, the coasts and islands are represented, but not the mountains or rivers (except the Nile), while perspective views of the cities and ports are given, with the flags of the various nations, as well as the Pope's line of demarcation between the spheres of Spain and Portugal. The place-names are written in various directions, but the most important are all to be read with the south at the top of the map, as was often the case at the time. In the centre there is a small circular inset, giving a general representation of the world, which is reproduced by Prof. Crinò. Owing to the obvious omission of a cypher from the date, this cannot be determined with certainty, but if, as Prof. Crinò plausibly suggests, the map is that known to have been made in 1534 for the historian Lorenzo Lomellino, the missing figure can be restored. The probability is strengthened by the fact that no other known map by Maggiolo shows in a single sheet the whole known world, as was to be the case in that made for Lomellino.

A Cartographical Monthly.—We are pleased to learn that the firm of Justus Perthes of Gotha have decided to commence the issue of a new monthly publication, intended to supply information on new publications in the field of cartography throughout the world. It will form a supplement to *Petermanns Mitteilungen* under the title *Kartographischen Monatsbericht*, and will be edited by Dr. H. Haack, whose previous services in a somewhat similar field, both as editor of the *Geographen-Kalendar* and as a collaborator in the *Geographisches Jahrbuch*, are substantial proofs of his competence for the work. It is intended to give the new publication the widest possible scope, by reporting exhaustively, not only on new maps (whether issued by governments or private firms), but on all publications dealing with cartography in its widest sense. The new venture, which should prove of the greatest value to all geographers, will realize one of the most important objects of the proposed "International Cartographical Association," the desirability of which has been repeatedly urged, especially by the late General von Tillo, at the meetings of the International Geographical Congress, though little progress has been made towards the practical realization of the idea.

OBITUARY.

Sir James Hector, K.C.M.G., F.R.S.

The late Sir James Hector, formerly Director of the Geological Survey of New Zealand and a Gold Medallist of this Society, whose death occurred at Petone, near Wellington, on November 6 last, belonged to a school of scientific students which the expansion of knowledge and the growth of specialization are fast tending to destroy. Though first and foremost a geologist, he was essentially an all-round student who took the whole realm of natural science as the field of his inquiry. His earliest associations were with the law. He was born at Edinburgh on March 16, 1834, the son of a Writer to the Signet, whose skill in reading ancient black-letter manuscripts of Scottish legend and history had often been exercised for the benefit of Sir Walter Scott. He himself, leaving school at a comparatively early age, served for a time in his father's office, and then was articled to a leading actuary

in the city. His bent for scientific study had, however, already begun to show itself, and was cultivated by attendance at the university classes. Here his industry and talents speedily brought him to the front, and finally he entered the university school of medicine, and, passing through, took his full M.D. degree at the early age of twenty-two.

A brief period, during which he acted as assistant to Sir James Simpson, was terminated by an offer which he received from Sir Roderick Murchison, acting on the recommendation of the university authorities, of a post as surgeon and geologist to the Government expedition under Captain John Palliser for the exploration of Western Canada. In this expedition, the despatch of which, in 1857, was largely due to the representations of the Royal Geographical Society, of which Sir Roderick Murchison was then President, young Dr. James Hector greatly distinguished himself. He took a leading part in the scientific work of the expedition, and carried out extensive explorations among the Canadian Rockies, discovering five passes, of which one, the Kicking Horse pass, is that by which the Canadian Pacific Railway now crosses the range. He traversed the auriferous valleys of British Columbia, visited the high-grade bituminous coal-area along the eastern shores of Vancouver island, and afterwards passed south through the mining regions of California and Northern Mexico before returning home by way of Panama and the West Indies.

Almost immediately after his return and the preparation of his reports on the scientific work of the expedition, Dr. Hector was offered the choice of geological appointments for which Sir Roderick Murchison had been asked to recommend candidates, one in Kashmir, and the other as geologist to the Provincial Government of Otago. He accepted the latter, and went out to New Zealand in 1861, about the time of the discovery of the Otago goldfields. During the next three years he was busily engaged in the exploration of the province, and did particularly good work in opening up practicable routes through the mountains between the east and west coasts of South island. In 1864 an account was read before the Society of one of his expeditions to the west coast of Otago, resulting in the discovery of a low pass from Martin's bay to Lake Wakatipu. What, however, first brought Dr. Hector prominently to public notice in New Zealand was his work as Government Commissioner for the Dunedin Exhibition of 1865, for the purposes of which he made a general tour through the colony. The gifts of organization he then displayed were afterwards utilized on several occasions, when he was called on to act as New Zealand Commissioner at exhibitions in Philadelphia (1876), Sydney (1879), Melbourne (1880 and 1888), and at the great Indian and Colonial Exhibition in this country in 1886.

Early in 1865 Dr. Hector was appointed Director of the Geological Survey of New Zealand, a post he held for just forty years. In this capacity, and as curator of the New Zealand museums, he did admirable work in placing knowledge of the structure and mineral wealth of the Dominion on a sound scientific basis. In addition to the annual reports of the Survey, numerous papers embody the results of his geological researches. In particular, he drew up, in 1866, the first general report on the coal-deposits of New Zealand, and of a more general character may be mentioned his 'Handbook of New Zealand.' He also took a keen interest in the collection of meteorological data, and was actively associated with the organization of the Botanical Gardens at Wellington. But perhaps in nothing was the wide range of his scientific sympathies and activities more prominently displayed than in connection with the New Zealand Institute, which, dating from 1868, embraces philosophical societies in various centres in the Dominion. Of this he acted from the commencement as manager, and edited with marked ability the voluminous *Transactions* of the Institute. In 1885 he was elected Chancellor of the New

Zealand University, and continued in office as Chancellor or Vice-Chancellor till 1903.

Many honours were showered on Sir James Hector in recognition of his scientific attainments and varied services to the empire. He was a member of numerous learned societies in Europe, America, and Australasia. Of this Society he was a Fellow from 1861 to 1890, and in 1891 was awarded the Founder's Medal "for the services rendered by him to geography by his papers on British North America and New Zealand." In 1866 he was elected a Fellow of the Royal Society, and in 1875 was awarded the Lyell Medal of the Geological Society. In 1874 he received the Order of the Golden Crown from the German Emperor, and in the following year was appointed a Companion of the Order of St. Michael and St. George. He was promoted to be Knight Commander in 1886.

Major-General Sir H. E. Colvile, K.C.M.G., C.B.

We regret to announce the death of Major-General Sir Henry Colvile as the result of a motor-bicycle accident at Frimley on November 24. In the course of a long and distinguished military career, Sir Henry Colvile saw a good deal of active service, mostly in various parts of Africa. Two journeys which he undertook in a private capacity at an early stage of his career are also of some geographical interest. In the closing weeks of 1879 and the early days of the following year, he travelled over the little-known route between Fez and Ujda, publishing an account of his experiences under the title, 'A Ride in Petticoats and Slippers' (1880); and in 1883, after a period of staff service in Cape Colony, made a route survey of the country between the head of the Gulf of Suez and the head of the Gulf of Akabah, and from the latter point up to the neighbourhood of the Dead sea. This latter journey he described in a volume entitled 'The Accursed Land' (1884). The next few years were occupied in active service in the Sudan campaigns, of which he was selected to write the official history, published in 1889. It was during these years that he gained the Companionship of the Bath. After participating in one of the Burma campaigns, he was called to Africa to assist in laying the foundations of British rule in Uganda. For a time he was Acting Commissioner, and directed the military operations against Kabarega, King of Unyoro. He himself personally covered the country between the northern end of the Victoria Nyanza and the Albert Nyanza, and received, in recognition of his services, first the C.M.G. and then the K.C.M.G. Order. Another sprightly volume from his pen, 'The Land of the Nile Springs,' described his experiences during this period. At the beginning of the South African war, Sir Henry Colvile commanded the Guards Brigade and later the 9th Division, and the controversy to which his conduct of the operations entrusted to him gave rise no doubt embittered the closing years of his life. Sir Henry became a Fellow of the Society in 1892.

MEETINGS OF THE ROYAL GEOGRAPHICAL SOCIETY, SESSION 1907–1908.

Second Meeting, November 25, 1907.—The Right Hon. Sir George T. Goldie, K.C.M.G., D.C.L., LL.D., F.R.S., President, in the Chair.

Elections.—*James Bond Ainsworth; Samuel Aitken; Geoffrey Archer; Paul N. Baker; Rev. Joseph Barker, M.A., D.D.; His Honour Judge J. W. Barth; Ralph James Dolby Belham; Bertrand Fangeres Bell; Leonard A. Bethell; William*

Battlescombe Bishop; Cyril Bowden; Percy Bramley; Charles Churchill Branch; Henry William Bush; Señor Don Guillermo R. Calderon; Samuel William Cartwright; Maurice Casenave; Captain Lionel Evelyn Oswald Charlton, D.S.O. (*20th Lancs. Fusiliers*); *George Charlwood; Alexander Smith Cochran; Frederic Abernethy Coleman; John Wallace Collett, M.D.; J. C. Bowen Colthurst; Clive Foster Cooper; Walter William Corner; George Phillip Doolette; R. B. Dunwoody; Joseph Patrick Fagan; Major Geoffrey Feilding, C.G., D.S.O.; W. R. Feldtmann; Ralph Wickham Flower; Harry Halton Fox* (*H.B.M. Consul, Ichang*); *John Arthur Freeman; J. Freundlich; Commander Cyril Moulden Fuller, R.N.; Francis John Childs Ganzoni; Captain G. J. P. Geiger* (*Royal Welsh Fusiliers*); *Major H. C. C. Gibbings* (*1st Royal Innis. Fusiliers, retired*); *Ernest Gibson; F. Bebbington Goodacre; George Lincoln Goodale, M.A., M.D., LL.D.; Major L. C. Gordon, R.G.A.; Thomas Edward Green; Captain Archibald Hay* (*2nd Batt. Royal Welsh Fusiliers*); *Lieut. E. James Headlam, R.I.M.; Walter Bells-Headley, M.A., M.D.; Charles Basil V. Hodgson, B.A.; Lieut. Godfrey Wm. Holdich, R.A.; Captain S. C. Houston, R.G.A.; Lieut. C. K. Howard-Bury* (*King's Royal Rifles*); *E. Francis Hyde; Rev. Wm. Remfry Hunt; James Hazen Hyde; Miles Irving, I.C.S.; George Douglas Johnston, B.A.; J. K. N. Kabraje; Albert Ernest Kitson; Captain Robert Thomas Lawless; Fredk. Swan Lawrence; Captain W. T. Layard* (*Northamptonshire Regt.*); *Alfred Tully Le Fevre; Herbert Liggins; Lieut. Raphael Lobez, R.N.R.; Theophilus H. Beavan Long; William Wyley Lord; Lieut. C. H. T. Lucas* (*Royal Berks. Regt.*); *George A. Macmillan; Captain Walter William MacGregor* (*Gordon Highlanders*); *Rev. William Herbert MacKean, M.A.; Peter MacQueen, D.D., U.S.; Major Henry John Madocks; Henry Noel Malan; Reuben Manton; Frederick Wm. Mitchell; Brig.-General B. R. Mitford, C.B., D.S.O.; C. A. W. Monckton; Lieut. M. R. C. Nanson, R.G.A.; Captain H. D. Pearson, R.E.; Robert Sutherland Rattray; Edward Arthur Read; Robert Renwick; Walter Francis Robinson; Otto Rothfield, I.C.S.; Captain R. S. Salkeld; Major Louis Livingstone Seaman; Major Herbert L. Showers, C.I.E., I.A.; Commander Alexander Simpson; Alexander Gilbert Smith; Robert C. Sticht; Rev. Hugh Wilson Tegart; Harold Lincoln Tungye; W. R. Taylor; Tsongloom Yuin Teijan; John Erskine Thomson, M.B., D.Ph.; Lieut. Raymond George Wavell-Paxton, C.G.; Wm. Welch; Captain J. R. L. Williams; Lieut. A. T. Wilson* (*Sikh Pioneers*); *David Miller Wilson, M.D.; St. John Winne; William McMichael Woodworth, A.B., A.M., Ph.D.; James Carleton Young.*

Sir Leopold M'Clintock.

The President said: Since we met here last, a fortnight ago, the country has lost, by the death of Admiral Sir Leopold M'Clintock, one of the finest and simplest characters of our time. I do not propose to say much about his life, because I belong almost to a younger generation (although I had the honour of being a friend of his), and I am not connected either with the Navy or with Arctic exploration; there are many living, many in our Society, who are far better qualified than I am to speak of that intrepid and gallant sailor and explorer. Sir Clements Markham has promised to write an obituary of Sir Leopold M'Clintock, which will appear in the January number of our *Journal*, and will deal fully with his career. I will only remind you that last summer we celebrated the sailing of the *Fox* under his command in search of the Franklin Expedition; and you will remember that Sir Leopold became famous on his return some forty-seven years ago, having successfully solved the problem of its fate. I will only say one or two words as to his long and close connection with our Society. He joined it in the year 1860, on his

return from his Arctic expedition. He was, therefore, forty-seven years a Fellow of the Society. During half that time he was a member of the governing Council, and for a considerable period he was a Vice-President. Even after he became an octogenarian he took an active and leading part in the joint committee of the Royal Society and the Royal Geographical Society, which directed the organization of the National Antarctic Expedition commanded by Captain Scott. In his own profession, the ranks of which teem with men of courage, energy, and devotion, he was, as we all know, looked upon as a shining light; and his long life, in all its phases, was a constant and practical response to that ever-flying signal, "England expects every man to do his duty."

The paper read was:—

"The Exploration of the Nun-Kun Mountain Group and its Glaciers." By Dr. W. Hunter Workman.

RESEARCH DEPARTMENT.

November 15, 1907. The Right Hon. Sir GEORGE T. GOLDIE, K.C.M.G., D.C.L., LL.D., F.R.S., President, in the Chair.

The paper read was:—

"Experiments on the Transporting Power of Sea Currents." By Dr. John S. Owen.

Third Meeting, December 9, 1907. The Right Hon. Sir GEORGE T. GOLDIE, K.C.M.G., D.C.L., LL.D., F.R.S., President, in the Chair.

ELECTIONS.—*John Abercromby Alexander; Francis Henry Anderson; Edmund Armstrong; Mervyn Worcester Howard Beech; Prof. Henry Freer Bray; Edward Lyell Bristow; Ernest Colville; James Fairgrieve, M.A.; F. W. Gard; Prof. Joseph Clark Hoppin, Ph.D.; John Hotchkiss; Lieut. H. G. Howell, R.F.A.; Frederick Kerr; Captain Chas. A. J. S. Langdale (Duke of Wellington's Regt.); George Scott Lowe; George W. Murray; Lieut. C. Patterson (Lancs. Fusiliers); C. Ernest Pearson; Harold Porter; Albert Ritter; Lieut. Alexander Ross-Hume (The Cameronians); Hugh A. Saunders; Lieut. E. C. Smith; Percy K. Stothert; Lieut.-Colonel George Waters.*

The paper read was:—

"The Jamaica Earthquake and After." By Dr. Vaughan Cornish.

GEOGRAPHICAL LITERATURE OF THE MONTH.

Additions to the Library.

By EDWARD HEAWOOD, M.A., *Librarian*, R.G.S.

The following abbreviations of nouns and the adjectives derived from them are employed to indicate the source of articles from other publications. Geographical names are as a rule written in full:—

A. = Academy, Academie, Akademie.
Abh. = Abhandlungen.
Ann. = Annals, Annales, Annalen.
B = Bulletin, Bollettino, Boletim.
Col. = Colonies.
Com. = Commerce.
C.R. = Comptes Rendes.
E. = Erdkunde.
G. = Geography, Géographie, Geografia.
Ges. = Gesellschaft.
I. = Institute, Institution.
Iz. = Izvestiya.
J. = Journal.
Jb. = Jahrbuch.
k.k. = kaiserlich und königlich.
M. = Mitteilungen.
Mag. = Magazine.
Mem. (Mém.) = Memoirs, Mémoires.
Met. (mét.) = Meteorological.
P. = Proceedings.
R. = Royal.
Rev. (Riv.) = Review, Revue, Rivista.
S. = Society, Société, Selskab.
Sc. = Science(s).
Sitzb. = Sitzungsbericht.
T. = Transactions.
Ts. = Tijdschrift, Tidskrift.
V. = Verein.
Verh. = Verhandlungen.
W. = Wissenschaft, and compounds.
Z. = Zeitschrift.
Zap. = Zapiski.

On account of the ambiguity of the words *octavo*, *quarto*, etc., the size of books in the list below is denoted by the length and breadth of the cover in inches to the nearest half-inch. The size of the *Journal* is 10 × 6½.

A selection of the works in this list will be noticed elsewhere in the "Journal."

EUROPE.

Austria—Istria. *G. Abhandlungen* **9** (1907): Heft 2, pp. iv. and 166. **Krebs.**

Die Halbinsel Istrien. Landeskundliche Studie von Dr. Norbert Krebs. *With Map, Illustrations, and Sections. Two Copies.*

Europe. **Moryson.**

An Itinerary, Containing His Ten Yeeres Travell through the Twelve Dominions of Germany, Bohmerland, Switzerland, Netherland, Denmark, Poland, Italy, Turkey, France, England, Scotland, and Ireland. Written by Fynes Moryson. Vols. 1 and 2. Glasgow: J. MacLehose & Sons, 1907. Size 9 × 6, pp. (vol. 1) xxvi. and 468; (vol. 2) viii. and 466. *Facsimile Plans. Price* 12*s.* 6*d. net per vol Presented by the Publishers.*

The original edition of this famous book is so scarce that this excellent reprint is particularly welcome. It is to be completed in four volumes.

France—Historical. **Brette.**

Armand Brette. Les limites et les divisions territoriales de la France en 1789. Paris: E. Cornély et Cie., 1907. Size 10 × 6½, pp. viii. and 134. *Maps. Price* 3*fr.* 50*c. Presented by the Publishers.* [To be reviewed.]

Italy—Lake Garda. *Abrégé B.S. Hongroise G.* **35** (1907): 30–32. **Prinz.**

Die Brandung am Ufer des Garda-Sees. Von Dr. G. Prinz. (*Földrajzi Közlemények* **35** (1907): 89–96. *With Illustrations.*)

Italy—Ornithology. **Giglioli.**

Avifauna Italica. Nuovo elenco sistematico delle specie di uccelli stazionare, di passaggio o di accidentale compassa in Italia . . . compilato dal dottore Enrico Hillyer Giglioli. Florence, 1907. Size 9½ × 6½, pp. xxiv. and 781. *Presented by the Author.*

Italy—Sardinia. *C.R.A. Sc. Paris* **144** (1907). 1182–1185. **Deprat.**

Les volcans du Logudoro et du Campo d'Ogieri (Sardaigne). Note de G. Deprat.

Italy—Sicily—Etna. **Lorenzo.**

Giuseppe de Lorenzo. L'Etna. Bergamo: Instituto Italiano d'arti Grafiche, 1907. Size 10½ × 7½, pp. 154. *Illustrations. Price* 5*s.*

The excellent illustrations give a good idea of the physical features of the mountain.

Italy—Tuscany. **Hutton.**

Florence and the cities of northern Tuscany, with Genoa. By Edward Hutton. London: Methuen & Co., 1907. Size 8 × 5, pp. x. and 436. *Sketch-map and Illustrations. Price* 6*s. Presented by the Publishers.*

Italy—Vesuvius. *Popular Sc. Monthly* **69** (1906): 558–566. **Eastman.**

Vesuvius during the Early Middle Ages. By Dr. Charles R. Eastman. *With Facsimile Illustrations.*

Luxemburg. *Tour du Monde* **13** (1907): 193-216. **Sixemonts.**

Le Grand-Duché de Luxembourg. Par Pierre Sixemonts. *With Sketch-map and Illustrations.*

Mediterranean. *Ann. G.* **16** (1907): 97-116. **Cayeux.**

Fixité du niveau de la Méditerranée à l'époque historique. Par L. Cayeux. *With Plan and Section.*

Mediterranean. **Philippson.**

Das Mittelmeergebiet: seine geographische und kulturelle Eigenart. Von Alfred Philippson. Zweite Auflage. Leipzig: B. E. Teubner, 1907. Size 9 × 6, pp. x. and 262. *Maps and Illustrations. Price* 7*m. Presented by the Publisher.*

The first edition of this work was noticed in the *Journal*, vol. **24**, p. 343. Some minor improvements have now been incorporated.

Rumania. *J.R. Statistical S.* **70** (1907): 122-129. **Gaster.**

Roumania's forty years' progress, 1866-1906. By Leon Gaster.

Russia. **Kirchhoff & others.**

Länderkunde von Europa, herausgegeben . . . , von Alfred Kirchhoff. Dritter Teil: Russland, von Prof. Dr. A. von Krasnow in Verbindung mit Prof. Dr. A. Woeikow. (Unser Wissen von der Erde, . . . herausgegeben von Alfred Kirchhoff; iv. Band.) Leipzig: G. Freytag, 1907. Size 11 × 7½, pp. viii. and 336. *Sketch-maps and Illustrations. Price* 22*m.* [To be reviewed.]

This well-known work is now completed after a long interval.

Russia—Arkhangelsk. *B.A. Imp. Sc., St. Pétersbourg*, 1907: 205-208. **Chernesheff.**

Quelques nouvelles données sur la géologie de la Bolchesemelskaïa Toundra. Par F. N. Chernesheff. [In Russian.]

Russia—Cartography. *M.G. Ges. Hamburg* **22** (1907): 125-172. **Michow.**

Weitere Beiträge zur älteren Kartographie Russlands. Von H. Michow. *With Facsimile Maps.*

A continuation of the author's former study of the early cartography of Russia.

Russia—Finland. **Leiviskä.**

Ueber die Oberflächenbildungen Mittel-Ostbottniens und ihre Entstehung. Von I. Leiviskä. Helsingfors, 1907. Size 9½ × 6½, pp. 114. *Maps and Illustrations. Presented by the Author.*

Servia. *Deutsche Rundschau G.* **29** (1907): 405-416. **Schlesier.**

Ergebnisse einer Wanderung durch Serbien. Von Emil Schlesier. *With Illustrations.*

Spain. **Bartoli.**

Atlas geográfico Ibero-American○. [Tomo i.] España: descripción geográfica y estadística de las provincias españolas, con el numero de habitantes, edificios y vivendas de cada Ayuntamiento, según resulta de los datos provisionales del Censo de 1897. Indice alfabético de los Ayuntamientos con la población de 1901. Por Manuel Escude Bartoli. Barcelona, [*not dated*]. Size 15 × 10½, pp. 536. *Purchased.*

Letterpress accompanying an atlas of Spain.

Switzerland—Census.

Schweizerische Statistik. 154. Lieferung. Ergebnisse der eidg. Betriebszählung vom 9. August, 1905. Band I. Die Betriebe und die Zahl der darin beschäftigten Personen. Heft 2. Kanton Bern. Bern, 1907. Size 11 × 8½, pp. xvi. and 496.

Switzerland—Glaciation. *Jahresber. G. Ges. Bern* **20** (1905-6): 1-230. **Nussbaum.**

Die eiszeitliche Vergletscherung des Saanegebietes. Von Dr. Fritz Nussbaum. *With Maps and Sections.*

Switzerland—Languages. *Questions Diplomatiques* **23** (1907): 423-431. **Henry.**

Enquête en Suisse sur les régions linguistiques allemands, françaises, italiennes et romanches. Par René Henry. *With Map.*

Switzerland—Valais. *Scottish G. Mag.* **23** (1907): 169-191, 225-239. **Newbigin.**

The Swiss Valais: a study in regional geography. By Marion J. Newbigin. *With Maps, Illustrations, and Diagrams.*

Turkey—Albania. **Nopcsa.**

Das katholische Nordalbanien. Eine Skizze von Dr. Franz Baron Nopcsa. (Separat aus "Földrajzi Közlemények," Budapest.) Vienna, [*not dated*]. Size 9½ × 6½, pp. 56. *Maps and Illustrations. Presented.*

United Kingdom—Coasts.

Royal Commission on Coast Erosion. Vol. 1, Parts i. and ii. Report, Minutes of Evidence, and Appendices thereto, of the Royal Commission appointed to inquire into and to report on certain questions affecting coast erosion and the reclamation of tidal lands in the United Kingdom. London, 1907. Size 13 × 8½, pp. (Part i.) vi.; (Part ii.) vi., 504, iv., and 156. *Plans. Price* 1*d. and* 8*s.* 9*d. Presented by the Royal Commission.* [To be noticed elsewhere.]

United Kingdom—Cornwall. *Quart. J. Geol. S.* **63** (1907): 106-123. **Jukes-Browne.**

The age and origin of the plateaus around Torquay. By Alfred John Jukes-Browne. *With Maps and Sections.*

United Kingdom—Leicester. **Johnson.**

Glimpses of ancient Leicester, in six periods. By Mrs. T. Fielding Johnson. 2nd edition. London: Simpkin & Co., 1906. Size 9 × 5½, pp. xvi. and 440. *Plans and Illustrations.*

This edition was prepared in connection with the visit of the British Association.

United Kingdom—Population.

Board of Agriculture and Fisheries. Report on the decline in the agricultural population of Great Britain, 1881-1906. London, 1906. Size 9½ × 6, pp. 144. *Map. Price* 8*d.*

United Kingdom—Scotland. *P.R.S. Edinburgh* **27** (1906-7): 14-15. **Wedderburn.**

The temperature of the fresh-water lochs of Scotland, with special reference to Loch Ness. By E. M. Wedderburn.

United Kingdom—Wales. **Strahan.**

Memoirs of the Geological Survey—England and Wales. The Geology of the South Wales Coalfield. Part ix. West Gower and the country around Pembrey. By Aubrey Strahan. London, 1907. Size 9½ × 6, pp. vi. and 50. *Map.*

ASIA.

Central Asia. **Fraser.**

The marches of Hindustan: the record of a journey in Thibet, Trans-Himalayan India, Chinese Turkestan, Russian Turkestan, and Persia. By David Fraser. Edinburgh: W. Blackwood & Sons, 1907. Size 9 × 5½, pp. xvi. and 522. *Map, Profile, and Illustrations. Price* 21*s. net. Presented by the Publishers.* [To be reviewed.]

Chinese Empire. **Bruce.**

In the footsteps of Marco Polo: being the account of a journey overland from Simla to Pekin. By Major Clarence Dalrymple Bruce. Edinburgh, etc.: Blackwood & Sons, 1907. Size 9 × 5½, pp. xiv. and 380. *Map and Illustrations. Price* 21*s. net. Presented by the Publishers.*

See Reviews, *ante*, p. 92.

Chinese Empire—Railways. **Kent.**

Railway enterprise in China: an account of its origin and development. By Percy Horace Kent. London: E. Arnold, 1907. Size 9 × 5½, pp. xii. and 304. *Maps. Price* 12*s.* 6*d. net. Presented by the Publisher.*

Chinese Empire—Tibet. **Francke.**

A history of Western Tibet; one of the unknown empires. By Rev. A. H. Francke. London: S. W. Partridge & Co., [1907]. Size 7½ × 5, pp. xiv. and 192. *Sketch-maps and Illustrations. Price* 2*s.* 6*d. net. Presented by the Publishers.* [To be reviewed.]

India. **Elwin.**

Indian jottings, from ten years' experience in and around Poona city. By Edward F. Elwin. London: John Murray, 1907. Size 9 × 5½, pp. xii. and 314. *Illustrations. Price* 10*s.* 6*d. net. Presented by the Publisher.*

India—Phytogeography. **Hooker.**

A sketch of the flora of British India. By Sir Joseph D. Hooker. (Reprinted from the third edition of the 'Imperial Gazetteer.') Oxford: Clarendon Press, 1906. Size 8¼ × 5½, pp. 60. *Presented by the Publishers.*

India—Travancore. **Aiya.**

The Travancore State Manual. By V. Nagam Aiya. 3 vols. Trivandrum, 1906.

Size 10½ × 7. *Maps, Plans, and Illustrations. Presented by the Secretary of State for India.*

A valuable compendium of present-day knowledge of the state, its archæology, history, religion, etc.

Japan. **Chamberlain and Mason.**

A handbook for travellers in Japan, including the whole empire from Saghalien to Formosa. By Basil Hall Chamberlain and W. B. Mason. 8th edit. London: John Murray, 1907. Size 7 × 4½, pp. x. and 570. *Maps, Plans, and Illustrations. Price* 20*s. Presented by the Publisher.*

Persia. *Petermanns M.* **53** (1907): 121–132. **Stahl.**

Reisen in Nord- und Westpersien. Von A. F. Stahl. *With Map.*

Persian Gulf and Persia. *M.G. Ges. Hamburg* **22** (1907): 69–124. **Stürken.**

Reisebriefe aus dem Persischen Golf und Persien. Von Alfred Stürken. *With Illustrations.*

Philippines. *Globus* **91** (1907): 271–272. **Kurtz.**

Kennzeichen von Niveauänderungen in den Philippinen. Von Kapitänleutnant Kurtz. *With Illustrations.*

Russia—Steppes. **Ivchenko.**

Le région periphérique du paysage des déserts en partie N. de la steppe de Kirghiz. Par A. Iwtschenko. (Extrait de l'*Annuaire géologique et minéralogique de la Russie*, vol. 6, livr. 4–5.) [St. Petersburg], 1903. Size 12½ × 10, pp. 103–114. [In Russian, *résumé* in French.]

Russia—Steppes. **Ivchenko.**

La dénudation de la steppe. Par A. Iwtschenko. Three parts. (Extrait de l'*Annuaire géologique et minéralogique de la Russie*, vol. 7, livraisons 2 and 7, et vol. 8, livr. 6–7.) St. Petersburg, 1906. Size 12 × 9½, pp. (part i.) 43–59; (part ii.) 216–240; and (part iii.) 135–197. *Illustrations.* [In Russian, *résumé* in French.]

See Review in vol. **30**, p. 553.

Siam—Survey.

Siam: General Report on the Operations of the Royal Survey Department, 1904–1905. Bangkok, 1906. Size 13 × 8½, pp. iv. and 56. *Maps and Illustrations.*

Turkey—Arabia Petræa. *National G. Mag.* **18** (1907): 283–291. **Hoskins.**

The Rock City of Petra. By Franklin E. Hoskins. *With Illustrations.*

Turkey—Palestine. **Macalister and Masterman.**

Palestine Explor. Fund, Quart. Statement (1907): 91–130

Diary of a Visit to Safed. By R. A. Stewart Macalister, with travel-notes of the journey from Nâblus to Safed *viâ* Beisân. By Dr. E. W. G. Masterman. *With Illustrations.*

Turkey—Railway. *Z. Ges. E. Berlin* (1907): 218–245, 288–320. **Blanckenhorn.**

Die Hedschâz-Bahn auf Grund eigener Reisestudien. Von Prof. Dr. Max Blanckenhorn. *With Maps and Illustrations.*

Western Asia. *B. Comité Asie française* **7** (1907): 193–197. **Lacoste.**

Conférence du Commandant de Lacoste [sur un voyage autour de l'Afghanistan]. *With Map.*

AFRICA.

Abyssinia. **Skinner.**

Abyssinia of to-day: an account of the first mission sent by the American Government to the court of the King of Kings. By Robert P. Skinner. London: E. Arnold, 1906. Size 9 × 5½, pp. xvi. and 228. *Sketch-map and Illustrations. Price* 12*s.* 6*d.*

See review in vol. **29**, p. 76.

Africa. **Landor.**

Across Widest Africa: an account of the country and people of eastern, central, and western Africa, as seen during a twelve months' journey from Djibuti to Cape Verde. By A. Henry Savage Landor. 2 vols. London: Hurst & Blackett, 1907. Size 10 × 6½, pp. (vol. 1) xvi. and 396; (vol. 2) xii. and 512. *Map and Illustrations. Price* 42*s. net. Presented by the Publishers.* [To be reviewed.]

Africa. **Heaton.**

A scientific geography. V. Africa. By Ellis W. Heaton. London: Ralph, Holland, & Co., 1907. Size 7½ × 5, pp. 110. *Sketch-maps and Diagrams. Price* 1s. 3d. *net. Presented by the Publishers.*

Africa. **Hall.**

A woman's trek from the Cape to Cairo. By Mary Hall. London: Methuen & Co., [1907]. Size 9 × 5½, pp. xvi. and 424. *Maps and Illustrations. Price* 16s. *net. Presented by the Publishers.* [See review, *ante*, p. 94.]

Central Africa. **Schillings.**

In wildest Africa. By C. G. Schillings. Translated by Frederic Whyte. 2 vols. London: Hutchinson & Co., 1907. Size 9½ × 6½, pp. xiv., viii., and 716. *Illustrations. Price* 24s. *net. Presented by the Publishers.* [To be reviewed.]

Congo State. **Frobenius.**

In Schatten des Kongostaates. Bericht über den Verlauf der ersten Reisen der D.I.A.F.E. [Deutschen Inner-Afrikanischen Forschungs-Expedition] von 1904-1906, über deren Forschungen und Beobachtungen auf geographischen und Kolonialwirtschaftlichem Gebiet, herausgegeben und bearbeitet von Leo Frobenius. Berlin: Georg Reimer, 1907. Size 10½ × 7, pp. xiv. and 468. *Maps and Illustrations. Price* 14m. *Presented by the Publisher.* [To be reviewed.]

Egypt and Sudan. **Hall.**

Handbook for Egypt and the Sudan. Edited by H. R. Hall. 11th edition. London: Stanford, 1907. Size 7 × 4½, pp. xiv., 170, 614. *Maps, Plans, and Illustrations. Price* 14s. *Presented by the Publisher.*

Eritrea. *Riv. G. Italiana* **14** (1907): 129-141. **Dainelli and Marinelli.**

Del Marahò: vulcano estinto della depressione Dancala. Osservazioni di G. Dainelli ed O. Marinelli. *With Map, Sections, and Illustrations.*

French Sudan. *La G., B.S.G. Paris* **15** (1907): 253-260. **Villatte.**

Le régime des eaux dans la région lacustre de Goundam (dépression Faguibine-Daounas-Télé-Fati). Par le Lieutenant Villatte. *With Map and Section.*

German East Africa. **Kohlschütter.**

Ergebnisse der Ostafrikanische Pendel-Expedition der Königl. Gesellschaft der Wissenschaften zu Göttingen in den Jahren 1899 und 1900, ausgeführt von Hans Glauning und Ernst Kohlschütter. Bearbeitet von Dr. Ernst Kohlschütter. I. Band. Berlin, 1907. Size 11 × 8½, pp. viii. and 230. *Map and Diagrams. Presented by the Author.*

German East Africa—Communications. **Prager.**

Z. Kolonialpolitik, etc. **9** (1907): 203-210.

Der Wasserweg zum Nyassasee. Von M. Prager.

German East Africa—Trade. *Z. Kolonialpolitik, etc.* **9** (1907): 431-451. **Hermann.**

Die Abschnürung Sansibars von Deutschostafrika. Von Dr. Rud. Hermann.

Discusses the commercial relation of Zanzibar to the opposite continental area which is compared with that of England to Western and Central Europe.

Madagascar—Ethnology. *Rev. Madagascar* **9** (1907): 81-91. **Ferrand.**

Le peuplement de Madagascar. Par Gabriel Ferrand.

Madagascar—Geology. *Rev. Madagascar* **9** (1907): 92-102. **Lemoine.**

Etat actuel de nos connaissances sur la géologie de Madagascar. Par P. Lemoine.

See note on these two papers in the August number (p. 214).

Morocco—Ujda. *Rev. française* **32** (1907): 219-231. **Mougin.**

Oujda. (D'après le capitaine Mougin.) *With Plan.*

Natal. **Anderson.**

Natal: Surveyor-General's Department. Third and final report of the Geological Survey of Natal and Zululand. By William Anderson. London, 1907. Size 12 × 8, pp. 300. *Maps and Plates. Presented by the Agent-General for Natal.*

Nigeria. *Petermanns M.* **53** (1907): 108-111. **Marquardsen.**

Zur Karte des Gebiets zwischen Ibi und Yola. Von Hauptmann Hugo Marquardsen. *With Map.*

The writer traversed the districts south of the Benue, both in German and English territory, in 1903.

North-West Africa—Trade. *G.Z.* **13** (1907): 126–142, 174–185. **Kürchhoff.**
Alte und neue Handelsstrassen und Handelsmittelpunkte in Nordwest-Afrika. Von D. Kürchhoff.

Rhodesia—Archæology. **Lamplugh and Balfour.**
Notes on the occurrence of stone implements in the valley of the Zambesi around Victoria Falls. By G. W. Lamplugh. Note on an implement of palæolithic type from the Victoria Falls, Zambesi. By H. Balfour. (From the *Journal of the Anthropological Institute*, vol. **36**, January–June, 1906.) London, 1906. Size 11 × 7½, pp. 159–171. *Maps and Illustrations. Presented by the Authors.*

Rhodesia—Historical. **Hall.**
The prehistoric gold mines of Rhodesia. By R. N. Hall. (Reprinted from the *African Monthly*.) Grahamstown: African Book Co., 1907. Size 9½ × 6½, pp. 46. *Presented by the Author.*
An answer to Mr. McIver, in which the author endeavours to show that the gold was not extracted between 900 and 1760 A.D. Certain at least of Mr. McIver's statements seem to be successfully refuted.

Rhodesia—Zambezi. **Lamplugh.**
The geology of the Zambesi Basin around the Batoka Gorge. By G. W. Lamplugh. (From the *Quarterly Journal of the Geological Society*, vol. **63**, 1907.) Size 8½ × 5½, pp. 162–216. *Map and Sections. Presented by the Author.*

Sahara. *La G., B.S.G. Paris* **15** (1907): 261–270. **Chudeau.**
D'Alger à Tombouctou par l'Ahaggar, l'Aïr et le Tchad. Par R. Chudeau. *With Map.*

Sahara. *Ann. G.* **16** (1907): 46–69, 117–138. **Gautier.**
Études Sahariennes. Par E. F. Gautier. *With Map and Illustrations.*

Sahara. *Renseignements Col., Comité Afrique française* (1907): 77–90. **Laperrine.**
La tournée à Taoudeni du Lieut.-Colonel Laperrine (26 mars—9 juillet, 1906). *With Map.*

Sahara. *Rev. française* **32** (1907): 273–283. **Mangin.**
Région du Tchad: le Borkou. (Rapport du capitaine Georges Mangin.)

Sahara. *Renseignements Col., Comité Afrique française* (1907): 53–57, 102–106. **Mussel.**
Du Touat à l'Acegradh et à l'Ahnet. Rapport de tournée du Lieut. Mussel.

Sahara—Ethnology. *Globus* **91** (1907): 379–384. **Goldstein.**
Die Thesaurierungspolitik der Saharabevölkerung. Von Ferdinand Goldstein.
The author treats of the camel in the rôle of personal property.

Sierra Leone. *Jahresber. G. Ges. Bern* **20** (1905–6): 231–249. **Volz.**
Eine Reise an die Flüsse Kittam und Bum in Sierra Leone. Von Dr. Walter Volz.

Somaliland—British. **Herbert.**
Two Dianas in Somaliland: the record of a shooting trip. By Agnes Herbert. London: John Lane, 1908 [1907]. Size 9 × 6, pp. viii. and 306. *Illustrations. Price* 12*s.* 6*d. net. Presented by the Publisher.* [See notice on p. 100, *ante*.]

South Africa. **Theal.**
History and ethnography of Africa south of the Zambesi, from the settlement of the Portuguese at Sofala in September, 1505, to the conquest of the Cape Colony by the British in September, 1795. By Dr. George McCall Theal. Vol. 1, The Portuguese in South Africa from 1505 to 1700. London: Sonnenschein & Co., 1907. Size 9 × 5½, pp. xxiv. and 502. *Map, Facsimile Plan, and Illustrations. Price* 7*s.* 6*d. Presented by the Publishers.*
This volume inaugurates a third edition, greatly extended in some directions, of the author's classical work on South Africa.

South Africa—Geology. **Corstorphine.**
The geological aspects of South African scenery. Presidential address to the Geological Society of South Africa, January 28, 1907. By Dr. Geo. Corstorphine. Johannesburg, 1907. Size 10 × 7, pp. xix.–xxvii.
See note in Monthly Record, vol. **30**, p. 562.

Sudan. **Alexander.**
From the Niger to the Nile. By Lieut. Boyd Alexander. 2 vols. London: E.

Arnold, 1907. Size 9½ × 7, pp. (vol. 1) xvi. and 358; (vol. 2) xii. and 420. *Maps and Illustrations. Price* 36*s. net. Presented by the Publisher.* [To be reviewed.]

Transvaal—Agriculture. *J.R. Col. I.* **38** (1907): 466–486. **Burtt-Davy.**
The agricultural and pastoral possibilities of the Transvaal. By Joseph Burtt-Davy.

Tripoli. *Riv. Coloniale* **3** (1907): 302–315. **Afrit.**
I confini e l'"hinterland" della Tripolitania. Di V. R. Afrit.

Tripoli. *Tour du Monde* **13** (1907): 169–192. **Mathuisieulx.**
La Cyrénaïque. Par H. de Mathuisieulx. *With Sketch-map and Illustrations.*

Tunis. **Loth.**
La Tunisie et l'œuvre du protectorat francais. Par Gaston Loth. Paris: Ch. Delagrave, 1907. Size 10 × 6½, pp. 282. *Illustrations and Diagrams. Price* 4 *fr. Presented by the Publisher.* [To be reviewed.]

West Africa—Boundary. *Questions diplomatiques* **23** (1907): 417–422. ——
La mission du Commandant Moll, Congo-Cameroun. By J.-H. F.
See note in vol. **29**, p. 676.

West Africa—Boundary. *Questions diplomatiques* **23** (1907): 495–498. ——
La mission du Capitaine Cottes, Sud-Cameroun. Par J.-H. F. *With Map.*
See note in vol. **29**, p. 676.

West Africa—Currency. *Rev. coloniale* (1907): 145–158. **Baillaud.**
Circulation monétaire en Afrique occidentale. Par Émile Baillaud.

NORTH AMERICA.

United States—Indian Territory. *B. American G.S.* **39** (1907): 321–340. **Condra.**
Opening of the Indian Territory. By G. E. Condra. *With Map and Illustrations.*

United States—Irrigation. *National G. Mag.* **18** (1907): 217–243. **Blanchard.**
Millions for moisture: an account of the work of the U.S. Reclamation Service. By C. J. Blanchard. *With Illustrations.*

United States—Mounds. *American J. Sc.* **23** (1907): 245–256. **Hobbs.**
Some topographic features formed at the time of earthquakes and the origin of mounds in the Gulf plain. By Wm. H. Hobbs. *With Sections and Illustrations.*
See Monthly Record, vol. **30**, p. 92.

United States—New Mexico. **Lee.**
U.S. Geol. Surv., Water-supply Paper, No. 188 (1907), pp. 60.
Water resources in the Rio Grande valley of New Mexico and their development. By Willis T. Lee. *With Maps and Illustrations.*

United States—New York. *American J. Sc.* **33** (1907): 325–335. **Carney.**
Wave-cut terraces in Kuka valley, older than the recession stage of Wisconsin ice. By Frank Carney. *With Illustrations.*

United States—New York. *B. American G.S.* **39** (1907): 193–199. **Heilprin.**
The Catskill mountains. By Prof. Angelo Heilprin. *With Map.*

United States—New York. *Monthly Weather Rev.* **35** (1907): 109–118. **Merriman.**
Rainfall and run-off of the Catskill mountain region. By Thaddeus Merriman. *With Map and Diagrams.*

United States—New York. *Monthly Weather Rev.* **35** (1907): 8–11. **Horton.**
The Adirondack rainfall summit. By Robert C. Horton. *With Map and Profile.*

United States—Population. *U.S. Bureau Census, B.* No. 71 (1907): pp. 28. ——
Estimates of population, 1904, 1905, 1906.

United States—South-East. *P. Boston S. Nat. Hist.* **33** (1907): 211–248. **Johnson.**
Drainage modifications in the Tallulah district. By Douglas Wilson Johnson. *With Sketch-maps and Illustrations.*

United States—Swamps. *National G. Mag.* **18** (1907): 292–301. **Wilson.**
Reclaiming the swamp lands of the United States. By Herbert M. Wilson. *With Map, Illustrations, and Diagram.*

United States—Triangulation. *U.S. Geol. Surv., B.* 310 (1907): pp. 248. **Gannett.**
Results of primary triangulation and primary traverse; fiscal year 1905-6. By Samuel S. Gannett. *With Map.*

United States—Utah. *National G. Mag.* **18** (1907): 199-204. **Holmes.**
The great natural bridges of Utah. By Edwin F. Holmes. *With Illustrations.*

CENTRAL AND SOUTH AMERICA.

Chile—Seismology. *Petermanns M.* **53** (1907): 132-138. **Steffen.**
Einige Ergebnisse der Untersuchungen über das mittelchilenische Erdbeben vom 16. August 1906. Von Dr. Hans Steffen. *With Map.*

Costa Rica—Cocos Island. **Biolley.**
Museo Nacional de Costa Rica. Mollusques de l'Isla de Coco. Par P. Biolley. (Resultats d'une expédition faite en janvier 1902, du 11 au 16, sous les auspices du Gouvernement de Costa Rica.) San José, 1907. Size 12 × 8½, pp. 30. *Map and Illustration.*
The writer visited the island, which lies midway between Central America and the Galapagos, for zoological research. He gives some notes on its physical and faunal relations.

Panama—Canal. **[Waldo.]**
The present status of the Panama Canal. [By Fullerton L. Waldo.] (Reprinted from *Engineering*, March 15, 1907.) London, 1907. Size 8½ × 5½, pp. 16. *Illustrations.*

Peru—Climatology. *Meteorologische Z.* **24** (1907): 270-279. **Hann.**
Zum Klima von Peru. (Mit Beobachtungen auf dem Mistigipfel in 5852 m.) Von J. Hann. *Also separate copy.*

Peru—Coast-line. *C.R.A. Sc. Paris* **144** (1907): 1180-1182. **Berthon.**
Contribution à l'étude des oscillations du rivage dans la baie du Callao. Note de P. Berthon.

South America—Ethnology. **Schuller.**
Sobre el orijen de los Charrúa. Replica al Dr. J. Friederici, de Leipzig. Por R. R. Schuller. Santiago, 1906. Size 10 × 6½, pp. 158. *Map. Presented by the Author.*
The Charrua Indians now occupy parts of Uruguay.

West Indies—Jamaica. *Popular Sc. Monthly* **70** (1906): 385-403. **Brown.**
The Jamaica earthquake. By Prof. Charles W. Brown. *With Maps and Illustrations.*

West Indies—Jamaica. ———
Correspondence relating to the Earthquake at Kingston, Jamaica, on January 14, 1907. Size 13 × 8½, pp. xviii. and 120. *Plan. Price* 1*s.* 5*d.* London, 1907.

West Indies—Jamaica. *J. Manchester G.S.* **22** (1906): 113-134. **Mellor.**
Jamaica, the Crown of our West Indian possessions. By E. W. Mellor. *With Illustrations.*

POLAR REGIONS.

Arctic Ocean. ———
Arctic Pilot. Vol. 1. Comprising the northern coasts of Russia from Voriema or Jacob river in Europe, to Cape North and the Wrangell islands in Asia, including a portion of the Arctic ocean, with the Barents, White, and Kara seas. Originally compiled by Commander H. S. Penn. Second edit. London, 1907. Size 9½ × 6, pp. xxxii. and 380. *Index-charts.*

Greenland. *Meddelelser om Grønland* **30** (1907): pp. xiv. and 1-314. **Kruuse.**
Botanical exploration of the east coast of Greenland between 65° 35′ and 74° 30′ lat. N. By Chr. Kruuse.

Polar Exploration. *G. Anzeiger* **8** (1907): 49-54. **Drygalski.**
Ziele und Methoden der Polarforschung nach den Verhandlungen des internationalen Kongresses zur Erforschung der Polargebiet in Brüssel. Von Erich von Drygalski. *With Map.*

Spitsbergen. *Monthly Weather Rev.* **35** (1907): 63–68.

Meteorological work at Camp Wellman, Danes Island, Spitzbergen.

On the work done by Mr. Hersey as a member of the Wellman expedition of 1906.

MATHEMATICAL GEOGRAPHY.

Longitudes. Klotz.

Department of the Interior, Canada. Transpacific Longitudes between Canada and Australia, and New Zealand, executed during the years 1903–1904. By Dr. Otto Klotz. Ottawa, 1907. Size 10 × 6½, pp. 31–198. *Map, Diagrams, and Illustrations. Presented by the Author.*

Surveying. *U.S. Geol. Surv., B.* 306 (1906): pp. 88. Gannett.

Manual of Topographic Methods. By Henry Gannett. *With Illustrations.*

Surveying. *Petermanns M.* **53** (1907): 97–108. Hammer.

Ueber die Bestrebungen der neueren Landestopographie. Von Prof. Dr. E. Hammer. *With Map.*

Surveying. Larminat.

E. de Larminat. Topographie pratique de reconnaissance et d'exploration, suivie de notions élémentaires pratiques de géodésie et d'astronomie de campagne. 2e édition. Paris: H. Charles-Lavauzelle, (1907). Size 9 × 5½, pp. 392 and 32. *Sketch-maps and Diagrams. Presented by the Author.*

See Review in the August number, p. 206.

PHYSICAL AND BIOLOGICAL GEOGRAPHY.

Geophysics. Ricciardi.

L'unità delle energie cosmiche. Di Leonardo Ricciardi. Turin, etc., [1907]. Size 10 × 6½, pp. 56. *Presented by the Author.*

The author thinks (*inter alia*) that the warm ocean currents are derived from the interior of the Earth, into which the sea-water has percolated.

Geophysics. *G.Z.* **13** (1907): 169–174. Tertsch.

Neuere Versuche zur physikalischen Lösung des Problems vom Erdinnern. Von H. Tertsch. *With Diagram.*

Glaciology—Erosion. Früh.

Ueber Form und Grosse der glazialen Erosion. Von Prof. Dr. J. Früh. (Separat-Abdruck a. d. Verhandlungen der Schweizer. Naturforschenden Gesellschaft in St. Gallen, 1906.) St. Gallen, 1907. Size 8½ × 5½, pp. 48. *Maps and Diagrams. Presented by the Author.*

Hydrology. Barrows and Horton.

U.S. Geol. Surv., Water Supply Paper, No. 187 (1907): pp. 94.

Determination of stream-flow during the frozen season. By H. K. Barrows and Robert E. Horton. *With Illustrations and Diagrams.*

Hydrology. *P.I. Civil Engineers*, **167** (1906–7): 181–185. Hill.

The yield of catchment areas. By Ernest Prescott Hill. (Discussion, pp. 186–261.)

Meteorology—Atmosphere. *Petermanns M.* **53** (1907): 138–139. Supan.

Die höchste Ballonfahrt. Von Dr. A. Supan. *With Diagram.*

Oceanography—North Atlantic. Poole.

P. and S. Nova Scotian I. Sc. **11** (1903–4): 193–198.

The sunken Land of Bus. By Dr. Henry S. Poole. *With Chart.*

The writer (who is not aware that the designation is to be traced to the *Busse of Bridgewater*, one of the ships in Frobisher's last voyage) calls attention to soundings near the locality in question by the cable-ship *Minia* in 1903. (Cf. Murray and Peake, in R.G.S. extra publication, 1904.)

Phenology. *J.R. Statistical S.* **70** (1907): 1–51. Hooker.

Correlation of the weather and crops. By R. H. Hooker.

Volcanic Phenomena. *C.R.A. Sc. Paris* **144** (1907): 1468–1470. Martel.

Sur les gouffres de la mer et la volcanisme. Par E. A. Martel.

The writer urges the importance of studying the question of the penetration of sea-water into submarine abysses.

OLDER WORKS ADDED TO THE LIBRARY AND MAP COLLECTION IN 1907.

BOOKS.

Anville, [J. B. B.] d'.—Géographie ancienne, abrégée. 3 vols. Size 6½ × 4. *Presented by Sir J. D. Hooker.* *Paris*, 1782.

Arctic.—[Collection of papers relative to the Expedition of 1875–6, commanded by Sir G. Nares.] 2 vols. *Maps and Illustrations.* Size 8½ × 5½. *Presented by Sir C. R. Markham.* *London*, 1865–79.

Bornhardt, W.—Zur Oberflächengestaltung und Geologie Deutsch-Ostafrikas. (Deutsch-Ost-Afrika, Band vii.) *Maps and Illustrations.* Size 11 × 7½. *Berlin*, 1900.

Coues, Elliott (Editor).—History of the expedition under the command of Lewis and Clark. 4 vols. *Maps and Portraits.* Size 9½ × 6. *London and New York*, 1893.

De la Martinière, H. M. P., and N. Lacroix.—Documents pour servir à l'étude du nord ouest africain. Vols. II.–IV. and Atlas. *Maps and Illustrations.* Size 11 × 7½. [*Algiers*], 1896–97.

Dupin, Charles.—Voyages dans la Grande-Bretagne. 6 vols (bound in 3). Size 10 × 8. *Presented by Sir J. D. Hooker.* *Paris*, 1820–24.

Forrest, Thomas.—A voyage from Calcutta to the Mergui Archipelago. *Maps and Illustrations.* Size 13 × 9½. *London*, 1792.

Hergt, G.—Die Nordlandfahrt des Pytheas. *Map.* Size 8½ × 5½. *Halle-a.-S.*, 1893.

Martius, Dr. C. F. P. von.—Beiträge zur Ethnographie und Sprachkunde Amerika's zumal Brasiliens. Band I. *Map.* Size 8½ × 5½. *Leipzig*, 1867.

Montanden, C. H.—Guide du voyageur en Crimée. *Maps and Illustrations.* Size 7½ × 4½. *Presented by Sir J. D. Hooker.* *Odessa*, 1834.

Müller, Dr. H. [Editor].—Al-Hamdâní's Geographie der Arabischen Halbinsel. 2 vols. [Arabic text and notes only.] Size 9½ × 6. *Leyden*, 1884–91.

[Müller, Salomon.]—Verhandelingen over de natuurlijke geschiedenis der Nederlandsche Overzeesche Bezittingen . . . uitgegeven . . . door C. J. Temminck. [Deel III.] Land- en Volkenkunde, door Salomon Müller. [*Plates only, four missing.*] Size 13 × 19. *Presented by Colonel W. J. Alt.* *N.P.*, 1844.

Navigation.—The safegarde of saylers, or Great Rutter. Translated . . . by Robert Norman. *Woodcuts.* Size 8 × 6. *Presented by Mr. H. Yates Thompson.* *London*, 1590.

Navigation.—The Rutter of the sea. . . . [Translated by Robert Copland.] Size 5½ × 4. *London*, [*circ.* 1560].

Parry, W.—A . . . discourse of the travels of Sir Anthony Sherley, by sea and overland to the Persian Empire. Size 8½ × 7. [MS. copy of the edition of] *London*, 1601.

Purchas, Samuel.—Purchas his Pilgrimage, or, Relations of the world, and the religions observed in all ages and places. . . . 4th edition. *Maps.* Size 13½ × 8½. *London*, 1626.

Vernon-Harcourt, L. F.—Rivers and canals. 2nd edition. 2 vols. *Maps, Sections, and Illustrations.* *Oxford*, 1896.

MAP.

Scheuchzer, Johann Jacob. Nova Helvetiæ tabula geographica. 2 sheets. 1712.

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By E. A. REEVES, *Map Curator*, R.G.S.

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G. Freytag's Touristen-Wanderkarte der Dolomiten. Scale 1 : 100,000 or 1 inch to 1·6 stat. mile. 2 sheets. Vienna: G. Freytag & Berndt, [1907]. *Price 2m. each sheet.* *Presented by the Publisher.*

Austria. **Hanslik**

Siedelungskarte der polnischen Westbeskiden vom Jahre 1900. Gezeichnet von Erwin Hanslik. Scale 1:150,000 or 1 inch to 2·4 stat. miles. Kultur- und Volksdichtekarten der polonischen Westbeskiden. Von Erwin Hanslik. Scale 1:600,000 or 1 inch to 9·5 stat. miles. *Petermanns Mitteilungen*, Erzanzungsheft, No. 158, Tafeln 3 u. 4. Gotha: Justus Perthes, 1907. *Presented by the Publisher.*

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England—London. **Bartholomew.**

Handy Reference Atlas of London and Suburbs. By J. G. Bartholomew, F.R.G.S. Edinburgh: John Bartholomew & Co., 1908 [1907]. *Price 2s. 6d. net. Presented by the Publisher.*

Although many of the plates of this atlas have appeared before, a considerable amount of time and labour has evidently been spent on their revision, and the result is a decidedly useful little atlas of London for handy reference. A special feature is the excellent index given at the end. In some districts further revision is still necessary to bring the maps up to date.

Europe—Central. **Freytag.**

G. Freytag's Automobil- und Radfahrer-Karten. Scale 1:300,000 or 1 inch to 4·7 stat. miles. Sheets: 9, Provinz Sachsen, Brandenburg; 30, Krain und Kustenland. Vienna: G. Freytag & Berndt, [1907]. *Price 1.35m. each. Presented by the Publisher.*

France. **Vallot.**

Environs de Chamonix, extraits de la Carte du massif du Mont Blanc, exécuté par Henri Vallot et Joseph Vallot d'après leurs triangulations et levés sur le terrain. Scale 1:20,000 or 3·2 inches to 1 stat. mile. Paris: Henry Barrère, 1907. *Presented by the Publisher.*

This map of the environs of Chamonix forms part of an entirely new survey of Mont Blanc and the immediate neighbourhood which during the past few years has been carried out by the authors, and the results of which it is intended to publish on a 1:20,000-scale map, consisting altogether of twenty-two sheets, as soon as the work upon the ground is completed. In general appearance this sheet resembles one of the Swiss Government Survey, but is on a larger scale. Contour-lines are given at intervals of 20 metres—on the land in brown, and on glaciers in blue. Roads, rockwork, and lettering are in black. In addition to the contours which are numbered in brown, many absolute heights are given in black figures. Care has been taken to distinguish by symbols the breadth and general character of the roads and tracks. In this edition, which is provisional only, the wooded lands are not indicated; but this will be done later on. The basis of the map is a careful triangulation, undertaken by MM. Henri and Joseph Vallot, and altogether the work is one of considerable merit and importance.

Sweden. **Sveriges Geologiska Undersökning.**

Sveriges Geologiska Undersökning. Scale 1:50,000 or 1·3 inch to 1 stat. mile. Sheets: Ser. Aa, Nos: 123, Jönköping; 131, Svinhult; 137, Västervik; 140, Boxholm. Stockholm: Sveriges Geologiska Untersökning, 1905–1907. *Presented by the Swedish Geological Institute.*

ASIA.

Indian Government Surveys. **Surveyor-General of India.**

Bengal and Central Provinces. Scale 1 inch to 1 mile. Sheets: 66, parts of districts Palamau and Ranchi (Bengal) and Sarguja State (C.P.), 1907. 92, parts of districts Palamau and Hazaribagh, 1907. 170, part of district Darbhanga, 1907. 184, district Manbhum, 1907. 208, parts of districts Sonthal Parganas, Manbhum, and Hazaribagh, 1907. 210, parts of districts Manbhum, Burdwan, and Bankura, 1907. 211, districts Manbhum and Bankura, 1907. 213, parts of districts Manbhum, Bankura, Midnapore, and Singhbhum, 1907. 237, parts of districts Burdwan, Bankura, and Birbhum, 1907. 238, parts of districts Bankura and Burdwan, 1907. 239, part of district Bankhura, 1907. 240, parts of districts Bankura and Midnapore, 1907. 261, parts of districts Burdwan and Bankura, 1907. 262, parts of districts Bankura, Burdwan, and Hughly, 1907. 268, parts of districts Midnapore and Balasore, 1895. 282, parts of districts Murshidabad, Birbhum, and Nadia, 1907. 288, parts of districts Howrah, 24-Parganas, and Midnapore, 1907. 289, parts of districts Howrah, Midnapore, and 24-Parganas, 1907. 306, parts of districts Nadia and Jessore, 1907.—Bombay Survey, scale 1 inch to 1 mile. Sheet 178, parts of districts Dungarpur (Rajputana Agency), Idar, and Sadra (Bombay), 1905.—Burma Survey, scale 1 inch to 1 mile. Sheets: 194, parts of districts Shwebo and Lower Chindwin, 1907. 206, parts of districts Thayetmyo, Taungu, and Yamethin, 1907. 207, parts of districts Prome, Thayetmyo, and Taungu, 1907. 339, 513, parts of Southern Shan States, 1907. 506, 507, parts of Northern and Southern Shan States, 1907.—Burma Survey, scale 1 inch to 4 miles. Sheet 93c, parts of Burma and the North and South Shan States, 1907.—Central India and Rajputana Survey, 1 inch to 1 mile. Sheets: 149, parts of states Dungarpur (Rajputana Agency), Idar and Sadra (Bombay), 1905. 289,

part of state Jaipur (Rajputana Agency), 1905. 318, parts of states Jaipur and Karauli (Rajputana Agency), 1905.—Central Provinces Survey, 1 inch to 1 mile. Sheets: 25, parts of districts Betul and Hoshangabad, 1903. 102, 124, 147, part of district Chanda, 1907. Central Provinces and Berar, 1 inch to 80 miles, 1906.—Madras Survey, 1 inch to 1 mile. Sheets: 78, part of district Mysore (Mysore), 1905. 102 and portion of 134, parts of districts Tumkur and Chitaldroog (Mysore), 1906. 133, parts of districts Chitaldrug and Tumkur (Mysore), 1906.—Punjab Survey, 1 inch to 1 mile. Sheets: 65, parts of districts Mianwali and Muzaffargarh, 1901. 224, parts of district Ferozepur and Faridkot State, 1906. 228, parts of districts Ferozepur and Hissar, 1902.—Sind Survey, 1 inch to 1 mile. Sheet 53, district Karachi, 1906.—Levels in Sind, 1 inch to 2 miles. Sheets 26, 27, districts Karachi, Larkhana, and Hyderabad, 1906.—District Sukkur, 1 inch to 4 miles, 1906.—United Provinces Survey, 1 inch to 1 mile. Sheets: 98, parts of districts Naini Tal, Pilibit, and Kheri, 1907. 122, parts of districts Rae-Bareli, and Unao, 1905. 130, parts of districts Kheri and Bahraich, 1907. 131, parts of districts Kheri, Sitapur and Bahraich, 1907. 132, parts of districts Kheri, Bahraich and Sitapur, 1907. 144, 146, part of district Bahraich, 1907. 227, 228, part of district Dehra Dun, 1907. Calcutta: Surveyor-General's Office, 1907. *Presented by the Secretary of State for India through the India Office.*

Japan. **Imperial Geological Survey, Tokyo.**

Topographical map of Japan. Scale 1: 200,000 or 1 inch to 3·2 stat. miles. Sheets: Kaseda, Suzumisaki. Tokyo: Imperial Geological Survey, 1907. *Presented by the Imperial Geological Survey of Japan.*

Siberia. **Ahnert and Khlaponin.**

Carte géologique de la région aurifère de la Sélemdja. Dressée par A. Khlaponin. Scale 1: 84,000 or 1 inch to 1·3 stat. mile. Sheets: 1 and 2. Carte géologique de la région aurifère de Zéia. Dressée par E. Ahnert. Scale 1: 84,000 or 1 inch to 1·3 stat. miles. Sheets: III.-2, III.-3, III.-4. St. Petersburg: Comité Géologique, 1905–07. *Presented by the Comité Géologique, St. Petersburg.*

AFRICA.

Africa. **Bartholomew.**

Central and South Africa. By J. G. Bartholomew, F.R.G.S. Scale 1: 5,000,000 or 1 inch to 79 stat. miles. Edinburgh: John Bartholomew & Co., [1907]. *Price, mounted in cloth, 3s. net. Presented by the Publishers.*

A new edition of a useful general map, with additions and corrections to railways, open and under construction. Seven plans of ports are given as insets. For some unexplained reason, hill-shading is given in the southern part of the map only.

Cape Colony. **Topographical Section, General Staff.**

Cape Colony. Reconnaissance Series. Scale 1: 250,000 or 1 inch to 3·9 stat. miles. Sheets: 128-A, Warmbad; 128-G, Little Bushmanland; 128-L, Strydenburg. London: Topographical Section, General Staff, War Office, 1907. *Presented by the Director of Military Operations.*

Congo State. **Lebègue.**

Carte de l'État Indépendant du Congo. Scale 1: 4,000,000 or 1 inch to 63·1 stat. miles. Brussels: J. Lebègue & Cie., [1907]. *Price 1.50fr.*

Egypt. **Survey Department, Cairo.**

Topographical map of Fayum Province. Scale 1: 10,000 or 6·3 inches to 1 stat. mile. Sheets: S.E. 11-1 and 12-1, 13-2, 14-2, 15-2, 18-1. S.W. 11-1, 12-2, 12-4, 12-5, 12-7, 13-1, 13-5, 13-6, 13-7, 13-8, 13-10, 14-7, 14-8, 14-9 and 10, 14-11, 14-12. Cairo: Survey Department, 1907. *Presented by the Director-General, Survey Department, Cairo.*

Gold Coast. **Guggisberg.**

Map of the Gold Coast. Published by the authority of Sir John Pickersgill Rodger, K.C.M.G., Governor, under the direction of Major F. G. Guggisberg, R.E., F.R.G.S., Director of Surveys, Gold Coast. Scale 1: 125,000 or 1 inch to 1·9 stat. mile. Sheets: 72-L-III., Kibbi (Kyebi). Edinburgh and London: W. & A. K. Johnston, 1907. *Price 2s. each sheet. Presented by Major F. G. Guggisberg, R.E., Director of Surveys, Gold Coast.*

Orange River Colony. **Murray and Cannon.**

Map of the Orange River Colony, compiled from recent surveys, diagrams, and other reliable sources by A. C. Murray, C.E., and Reginald Cannon, A.M.I.M.E. Scale 1:

253,440 or 1 inch to 4 stat. miles. 4 sheets. Johannesburg: The Drawing Office, 1907. *Presented by A. C. Murray, Esq.*

An uncoloured outline map, without hill-shading, showing farm boundaries, railways, mines, rivers, roads, and other useful information. In its compilation, besides the personal observations and surveys of Mr. A. C. Murray, farm diagrams, and the surveys of railway and mining engineers have been utilized, and the map has been completed from the degree sheets published by the Surveyor-General of the Orange River Colony. The preparation and drawing must have entailed a considerable amount of labour, but the map will doubtless be of great service. It is in four sheets, each measuring 35 inches by 43 inches.

Transvaal. **Murray.**

Map of portion of the Zoutpansberg, showing the Messina-Seta district. By A. C. Murray, C.E. Scale 1: 80,000 or 1 inch to 1·3 stat. mile. Johannesburg: The Drawing Office, 1907. *Presented by A. C. Murray, Esq.*

A blue print showing farm boundaries, mining claim boundaries, discoverers' rights, roads, and rivers and watercourses, compiled from farm surveys under the supervision of mining engineers, prospectors, and others acquainted with the district.

AMERICA.

Canada. **Dept. of the Interior, Ottawa.**

Standard topographical map of Canada. Scale 1: 250,000 or 1 inch to 3·9 stat. miles. Sheets: 1 N.W. and 1 N.E. Guelph, Ontario; 15, Cape Breton, Quebec. Ottawa: Department of the Interior, 1906–07. *Presented by the Department of the Interior, Ottawa.*

Canada. **Dept. of the Interior, Ottawa.**

Railway map of the Dominion of Canada. Scale 1: 6,336,000 or 1 inch to 100 stat. miles. Ottawa Department of the Interior, 1907. *Presented by the Department of the Interior, Ottawa.*

This is a useful outline map giving, by means of the symbols and colours in which the lines are laid down, and by tables of distances, complete information concerning the railways and railway systems of the Dominion up to date. Among the latter is a table showing the lengths of lines constructed in 1906, and in another the lengths of all the lines in the present year are given.

Canada. **Dept. of the Interior, Ottawa.**

Maps showing the electoral divisions in Southern Saskatchewan and Southern Alberta. Scale 1: 792,000 or 1 inch to 12·5 stat. miles. Ottawa: Department of the Interior, 1907. *Presented by the Department of the Interior, Ottawa.*

These maps show the Dominion Electoral Divisions, according to the Representation Act of 1906.

Canada. **Dept. of the Interior, Ottawa.**

Map of Manitoba, Saskatchewan, and Alberta. Scale 1: 792,000 or 1 inch to 12·5 stat. miles. 3 sheets. Ottawa: Department of the Interior, [1907]. *Presented by the Department of the Interior, Ottawa.*

GENERAL.

World. **Frech.**

Tektonische und seismologische Uebersichtskarte der Erde. Von Prof. Dr. Fritz Frech. *Petermanns Mitteilungen*, Jahrgang 1907, Tafel 19. Gotha: Justus Perthes, 1907. *Presented by the Publisher.*

These two maps accompany Prof. Fr. Frech's paper, "Erdbeben und Gebirgsbau," in *Petermanns Mitteilungen* for November last.

World. **Harmsworth.**

Harmsworth Atlas and Gazetteer. Parts 28 and 29. London: The Amalgamated Press, Limited, 1907. *Price 7d. each part.*

These parts contain the following maps:—Part 28: Nos. 71–72, East Hungary, Galicia, and the Austrian Tyrol; 167–168, United States (general map); 205–206, Western Australia. Part 29: No. 75–76, Western Spain and Portugal; 123, Borneo, Sumatra and Java; 124, the Philippine Islands; 191–192, South America, Brazil.

World. **Hondius.**

Hondius' World Map, 1611, by Jodocus Hondius. Edited by Edward Luther Stevenson, PH.D., and Joseph Fischer, S.J. Facsimile issued under the joint

auspices of the American Geographical Society and the Hispanic Society of America, New York, 1907. *Price* £5 15*s*.

This map will be specially noticed.

World. **Rothaug and Zucalli.**

Atlante Geografico ad uso delle Scuole cittadine, del J. G. Rothaug e M. Zucalli. Vienna: G. Freytag & Berndt, [1907]. *Price* 2.80 *Cr. Presented by the Publisher.*

A school atlas, principally consisting of maps of European countries, although a few small-scale general maps of other continents are added. On the larger-scale maps relief is effectively shown by a combination of vertical hachuring and colour tinting. The maps are clear, boldly drawn, and not overcrowded.

CHARTS.

Admiralty Charts. **Hydrographic Department, Admiralty.**

Charts and Plans published by the Hydrographic Department, Admiralty, during October, 1907. *Presented by the Hydrographer, Admiralty.*

New Charts.

No.	Inches.	
3607 m =	3·0	Scotland, west coast:—Sound of Mull, eastern portion. 3*s*.
3669 m =	6·9	Scotland, west coast:—Uig bay. 2*s*.
156 m =	1·42	Sweden:—Väderöbod to Måseskär. 5*s*.
129 m =	1·42	Sweden:—Måseskär to Vinga. 5*s*.
3667 m =	0·73	Sweden:—Nidingen to Tylö. 3*s*.
3671 m =	{0·72 / 1·80}	Sweden:—Tylö to Viken, Halmstad harbour. 2*s*.
2580 m =	3·0	United States, east coast: East river and northern approaches to New York. 3*s*.
3658 m =	0·48	Formosa, north coast:—Auran road to So O wan. So O wan (*Suao bay*). 3*s*.
128 m =	1·5	Japan, inland sea:—Channels between Bingo nada and Ozuchi jima. 3*s*.

New Plans and Plans added.

4 m =	{1·9 / 6·0}	Principal groups of the Chagos archipelago. New Plan:—Salomon islands. Plan added:—Entrance to Lagoon. 2*s*.
991 m =	4·0	Japan. Anchorages on the coasts of Yezo island. New plan:—Mombetsu anchorage. 2*s*.

Charts Cancelled.

No.	Cancelled by.	No.
2254 Ireland, west coast:—Tralee bay to Liscanor bay, including River Shannon. Plans of Tarbert road and Foynes island on this sheet.	—	—
156 Sweden: Måseskär to Hällö, including approaches to Kingshamn.	New chart. Väderöbod to Måseskär	156
129 Sweden: Hönö to Paternosters and approaches to Marstrand and Kladesholm.	New chart. Måseskär to Vinga	129
678 North American lakes:—Lakes Erie and Huron. Plan of Port Huron on this sheet.	—	—
2376 Harbours in Formosa. Plan of Suao bay on this sheet.	Plan of So O wan (*Suao bay*) on new chart.	3658
2407 Plans in Russian Tartary:—Tumen Ula.	—	—
128 Japan:—Channels between Bingo Nada and Ozuchi sima.	New chart. Channels between Bingo Nada and Ozuchi jima	128

Charts that have received Important Corrections.

No. 2472, Scotland, west coast:—Loch Gilp, East loch Tarbert, Millport. 2639, Scotland, west coast:—Loch Carron and Loch Kishorn. 109, England, east coast:—Entrance to the river Humber, Grimsby road. 196, Sweden:—Nidingen to Hönö. 2158*a*, Mediterranean sea, western sheet. 2158*b*, Mediterranean sea, eastern sheet. 2516, Gulf of St. Lawrence and the river to Quebec. 472, Harbours and anchorages of Haïti or San Domingo. 2820, Gulf of Mexico:—Entrance to Pensacola bay. 627, Africa, west coast:—St. Paul de Loanda to Great Fish bay. 748*a*, Indian ocean, southern portion. 748*b*, Indian ocean, northern portion. 40, India, west coast:—Karachi harbour. 833, Bay of Bengal:—Rangoon river and approaches. 776, China sea: Shieng Mun to Tra ko island. 854, China, east coast:—Port Swatau. 2400, China, east coast:—The bar and approaches to the river Min. 3585, China, north-east coast:—Approaches to the Wusung river. 3025, China, north-coast:—Wei hai wei anchorage. 452 Japan:—Yezo island with adjacent straits. 214, Solomon islands.
(J. D. Potter, Agent.)

Danish Charts. **K. Danske Søkort-Arkiv.**

Danish Hydrographic Charts, Nos.: 55, Island og Færöerne; 150, Nordsöen, Horns Rev; 160, Vestlige del af Östersöen til 16° 30′ Ö. Længde, samt sundet og Belterne; 167, Graadyb; 215, Odense-Fjord; 217, Islands Nordkyst, Steingrimsfjördr; 218, Dansk Vestindien, St. Thomas Havn. Copenhagen: Kongelige Danske Søkort-Arkiv, 1906-07. *Presented by the Danish Admiralty.*

Indian Ocean and Red Sea. **Meteorological Office.**

Monthly meteorological charts of the Indian Ocean north of 15° S. lat. and Red Sea. December, 1907. London: Meteorological Office, 1907. *Price 6d. each. Presented by the Meteorological Office.*

North Atlantic. **U.S. Hydrographic Office.**

Pilot chart of the North Atlantic Ocean, November, 1907. Washington: U.S. Hydrographic Office, 1907. *Presented by the U.S. Hydrographic Office.*

North Atlantic and Mediterranean. **Meteorological Office.**

Monthly meteorological charts of the North Atlantic and Mediterranean, December, 1907. London: Meteorological Office, 1907. *Price 6d. each. Presented by the Meteorological Office.*

North Pacific. **U.S. Hydrographic Office.**

Pilot chart of the North Pacific Ocean, December, 1907. Washington: U.S. Hydrographic Office, 1907. *Presented by the U.S. Hydrographic Office.*

PHOTOGRAPHS.

Asiatic Turkey and Persia. **Loraine.**

Fifty-seven photographs of Asiatic Turkey and Persia, taken by Percy L. Loraine, Esq., of the British Legation, Tehran, 1907. *Presented by Percy L. Loraine, Esq.*

Taken during a journey made in March, April, and May of the present year, from Constantinople to Tehran *vid* Beirut, Damascus, Aleppo, thence overland to the Reskéné on the Euphrates, and down that river to Basra. From Basra Mr. Loraine travelled through Persia to Isfahan *viâ* Ahwaz, and thence north to Tehran. Parts of the route are little visited by Europeans, hence the photographs have a special value.

(1) Camel caravan at Mersina; (9) Custom house, Mersina; (3) North Lebanon and Mount Sunnin from the railway; (4 and 7) Damascus; (5) Example of Arab architecture in the citadel of Aleppo; (6) The citadel gateway, Aleppo; (8 and 9) Aleppo; (10) The banks of the Euphrates at Meskene; (11) On board the *Shakhtour*; (12) Arabs watering their herds in the Euphrates; (13) *Shakhtour* at Anah, on the Euphrates; (14) An island in the Euphrates near Anah; (15) The Euphrates at Anah; (16) Mid-day halt on the road between Felludja and Baghdad; (17) Pontoon bridge on the Tigris; (18 and 19) Kut-el-Amara; (20) A "guffa" at Kut-el-Amara; (21) Arab boys diving at Amara; (22) Amara; (23) Quay at Amara; (24) Native sailing craft on the Tigris; (25) Ezra's tomb; (26) Junction of the Euphrates and Tigris at Gurneh (Korna); (27) Shatt-el-Arab; (28) A "bellum" on the Shatt-el-Arab; (29-34) Basra creek; (35) Two steamers belonging to Sheikh Khazzal on the Karun river near Bander Naseri (Ahwaz); (36) The Euphrates and Tigris Steam Navigation Company's S.S. *Malamir* at Bander Naseri; (37) On the Bakhtiari road near Jaru; (38) On the Bakhtiari road near Cheshin-i-roghan; (39 and 40) Ala Khorshid; (41-43) Camp of Shahab es Saltaneh, Malamir; (44) Bakhtiari tribesmen; (45) Between Malamir and

Tul-i-Shalu; (46) The Karun gorge at the Shalu bridge; (47) The Shalu bridge; (48) Between Sarkhun and Dopulan; (49) Bridge over Karun near Dopulan; (50) House of Shahab es Saltaneh at Ardal; (51) Ardal; (52) View from the entrance of the Tang-i-Darkesh Warkesh gorge; (53–55) Tang-i-Darkesh Warkesh; (56) The Zendeh Rud near Bistagun; (57) Isafahan-Tehran road near Isfahan.

China. **Davies.**

Fifty-six photographs of Southern Chiang-su and Northern Chê-chiang, China, taken by Major H. R. Davies, 52nd Oxfordshire Light Infantry. *Presented by Major H. R. Davies.*

These photographs represent in a striking manner the characteristic scenery of the Yang-tzŭ delta, as well as the mode of life and industries of the inhabitants. Some of the views are panoramas.

(1 and 2) Wooden bridge; (3) Stone arch bridge; (4 and 5) Stone arch bridge, Grand canal; (6) Three-arch stone bridge; (7) European house-boat; (8–10) Chinese house-boats; (11) Ferry-boat; (12 and 14) Small cargo boats; (13 and 15) Big cargo boats, Grand canal; (16) Wheelbarrow near Shanghai; (17) Wheelbarrow loaded with cotton; (18) Cormorant fishers; (19) Machine for drawing up water for irrigation, worked by a buffalo; (20) Shed of irrigating machine; (21) Cormorant fishers at work; (22) Broken bridge; (23) A typical village; (24) Pagoda at Ping-wu; (25) A typical big creek; (26) Typical scenery; (27) A village; (28) Fishing-nets; (29) Naik Vishnu Gaode, surveying; (30) Sifting corn; (31–38) Village men and boys; (39–45) Village women and children; (46–49) Typical scenery; (50) The "Hills" 20 miles west of Shanghai; (51) A typical big creek; (52) A typical village; (53) Bridge over Grand canal near Za-mên; (54) Northern part of Ping-wu; (55) Eastern suburb of Ping-wu; (56) Ka-hsing Fu from outside west gate.

New Zealand. **Martin.**

Six photographs of the Great Tarawera Volcanic Rift, New Zealand, taken by J. Martin, Auckland, New Zealand. *Presented by Dr. J. Mackintosh Bell, M.A.*

(1) Mount Tarawera after eruption; (2 and 3) The White Terrace; (4) White Terrace eruption; (5 and 6) The Pink terrace.

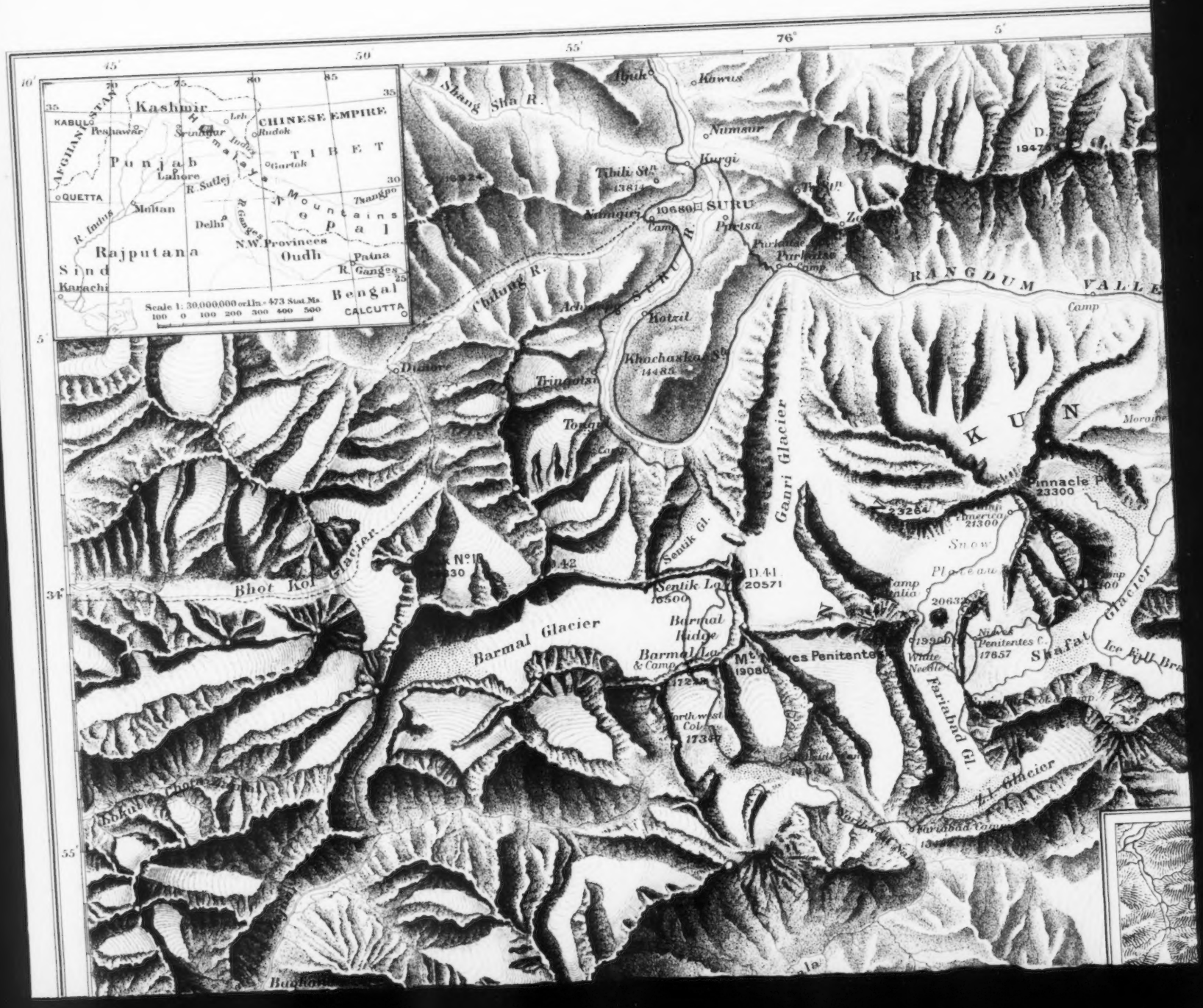
New Zealand. **New Zealand Government.**

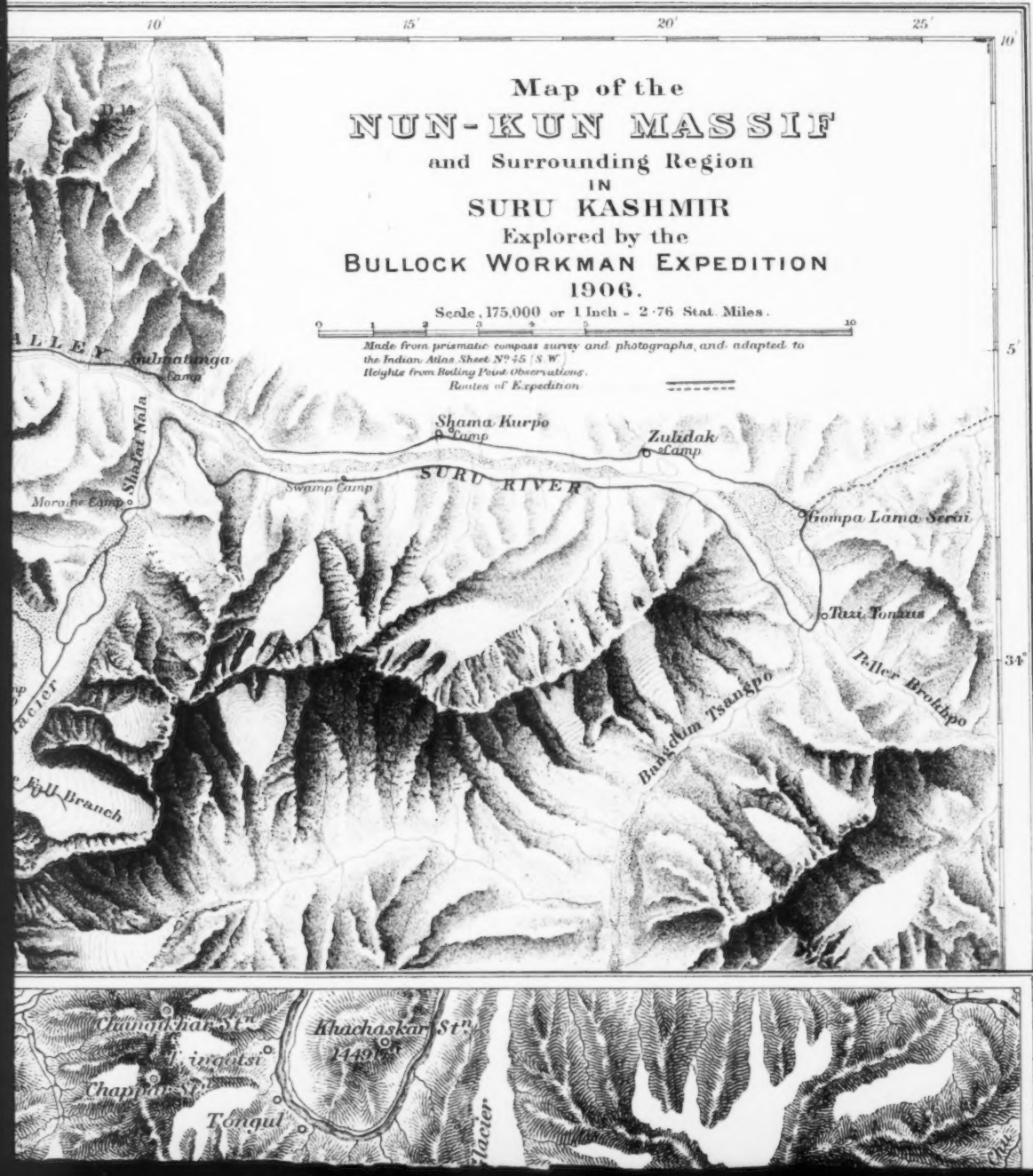
Forty-one photographs of the Southern Alps of New Zealand, taken by the New Zealand Government Tourist Department. *Presented by Dr. Mackintosh Bell, M.A.*

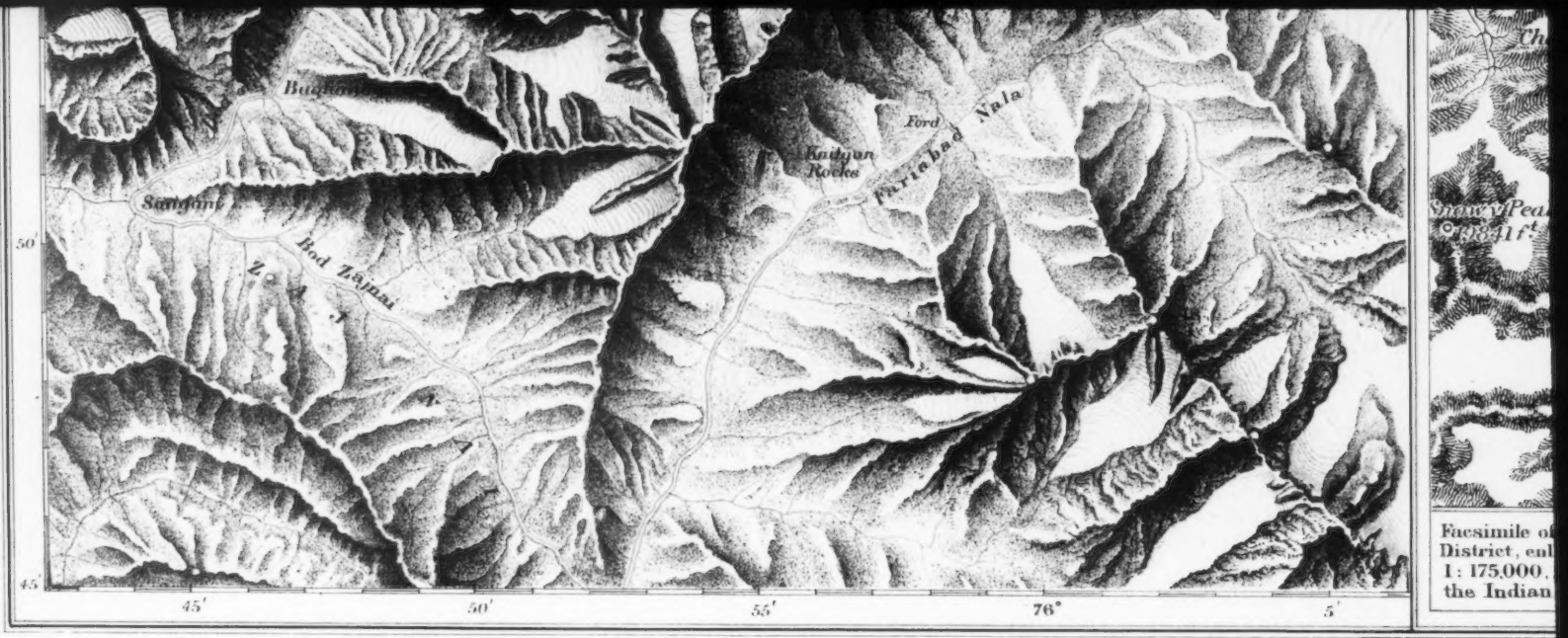
A beautiful series of photographs, recently exhibited by Dr. Mackintosh Bell at a meeting of the Society on the occasion of the reading of his paper. Some of the glacier and snow views are very good.

(1) Mount Cook from Mueller moraine; (2) Mount Cook and St. David's Dome; (3) Mount Sefton; (4) Mount Sefton from Hermitage; (5) Mount Sefton in storm clouds; (6) The Footstool from Seeley range; (7) Entrance of Hooker valley; (8) Mount Cook and the Hooker river; (9) Looking up Hooker valley to La Perouse and Baker's Saddle; (10) Ball hut from lateral moraine; (11) Mount Malte Brun from Constance glacier; (12) Malte Brun range from Ball pass; (13 and 14) De la Bêche and Minaret peaks, with Ranfurly and Constance glaciers; (15 and 16) Looking down Tasman glacier; (17) Looking up Tasman glacier from Ball pass; (18) Looking down Tasman glacier from Malte Brun; (19) On Tasman glacier, ice-ridges; (20–22) Head of Tasman glacier; (23) Mounts Tasman and Silverhorn; (24) Sunset, upper Tasman glacier; (25) Copland range and Lyttel glacier; (26) Top of Copland pass; (27) Looking across Welcome Flat and Copland river; (28 and 29) In Copland valley; (30) Junction of Copland river and Architect creek; (31) The Footstool, Moorehouse range, and Copland pass; (32) Looking up Copland valley, Ryan's peak; (33) Mount Glorious, Copland valley; (34) Hochstetter ice-falls; (35) Amongst broken ice, Hochstetter ice-falls; (36) Ice valley, Hochstetter ice-falls; (37) Minaret and de la Bêche from Hochstetter ice-falls; (38) Ice cave, Hochstetter ice-falls; (39) Mount Cook; (40) Mount Cook lillies; (41) From Fairy cove, Manapouri.

N.B.—It would greatly add to the value of the collection of Photographs which has been established in the Map Room, if all the Fellows of the Society who have taken photographs during their travels, would forward copies of them to the Map Curator, by whom they will be acknowledged. Should the donor have purchased the photographs, it will be useful for reference if the name of the photographer and his address are given.

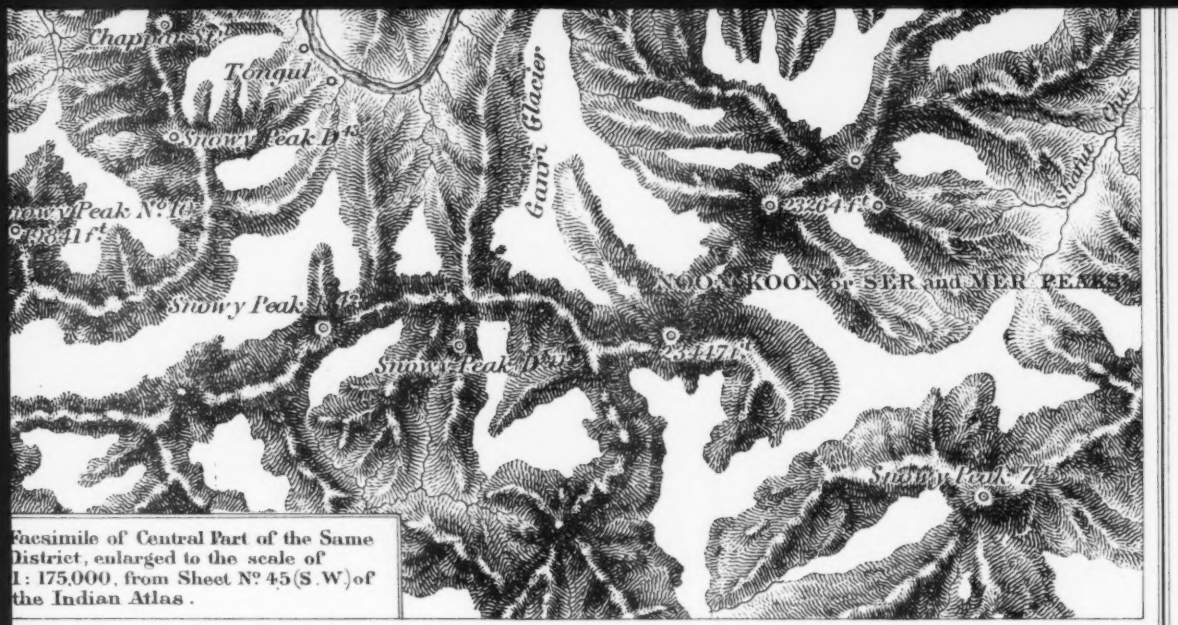

Kashmir
CHINESE EMPIRE
TIBET
Punjab
Lahore
R. Sutlej
Himalaya Mountains
Rajputana
Sind
N.W. Provinces
Oudh
Patna
Bengal
Delhi
Multan
QUETTA
Karachi
CALCUTTA
Peshawar
Srinagar
Leh
Rudok
Gartok
Tsangpo
R. Indus
R. Ganges
Scale 1: 30,000,000 or 1 In. = 473 Stat. Ms
Shang Sha R.
Kurgi
Tabli St.
Namgiri
SURU
Purtsa
Purtsa Camp
Chulong R.
Hotzil
Khachaskan St.
14485
Trinoktan
Ganri Glacier
RANGDUM VALLEY
KUN
Pinnacle Pk
23300
Snow Plateau
Sentik Gl.
Sentik La
16500
D41
20571
Bhot Kol Glacier
Barmal Glacier
Barmal Ridge
Barmal La & Camp
Mt. Penitentes
19086
Penitentes C.
17857
White Needle
Farkabad Gl.
Shafat
Ice Fall Glacier
Buddha


10'
15'
20'
25'
10'
5'
34°
Map of the
NUN-KUN MASSIF
and Surrounding Region
IN
SURU KASHMIR
Explored by the
BULLOCK WORKMAN EXPEDITION
1906.
Scale, 175,000 or 1 Inch = 2·76 Stat. Miles.
0 1 2 3 4 5 10
Made from prismatic compass survey and photographs, and adapted to the Indian Atlas Sheet N°45 (S.W.)
Heights from Boiling Point Observations.
Routes of Expedition
Sulmatunga Camp
Shadar Nala
Moraine Camp
Shama Kurpo Camp
Zulidak Camp
Swamp Camp
SURU RIVER
Gompa Lama Serai
Tuzi Tonzus
Peller Brokpo
Badgdum Tsangpo
Kull Branch
Changushan Stn
Khachaskar Stn
14490
Tonqul
Glacier



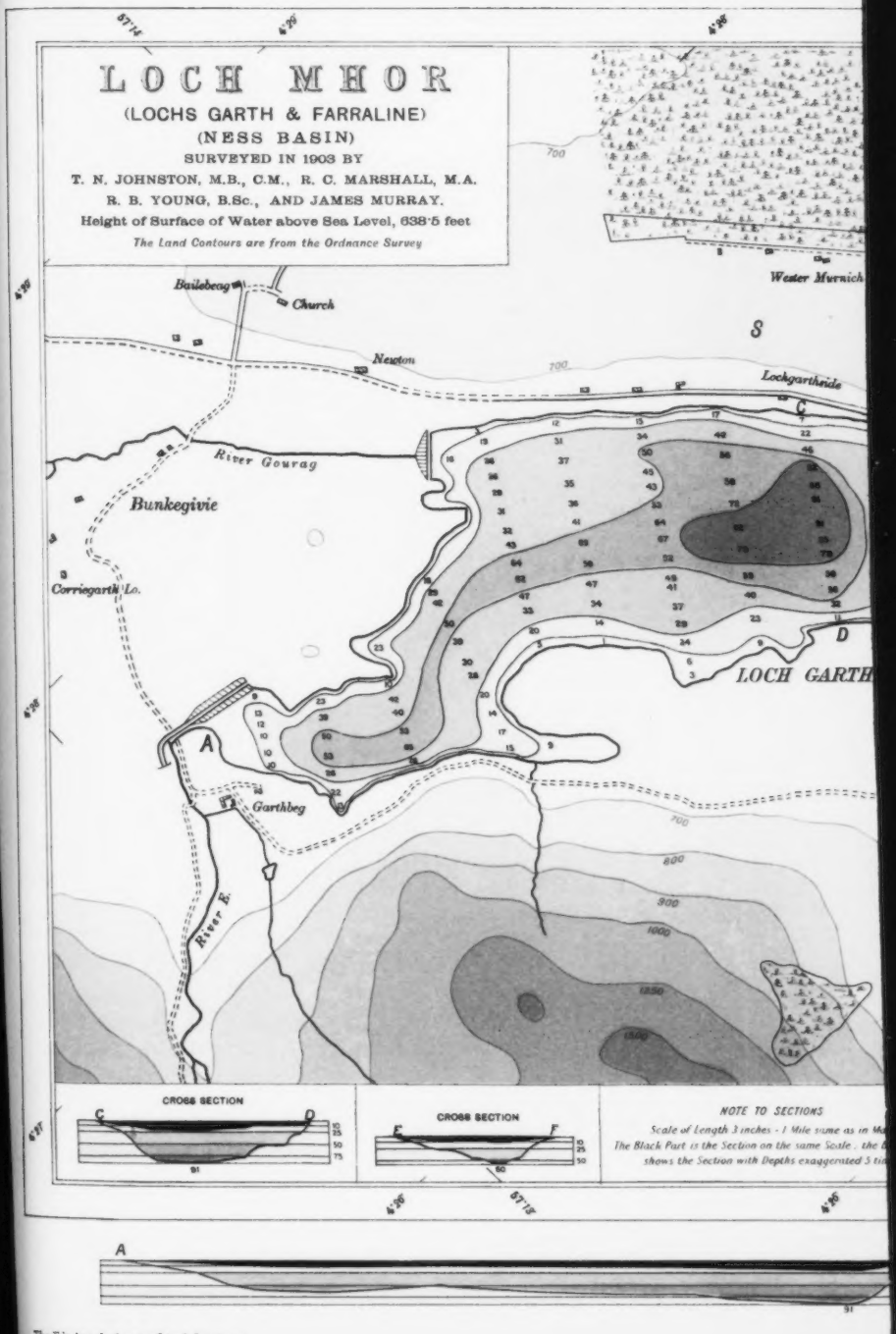
Facsimile of
District, enl
1: 175,000,
the Indian

Published by the Royal Geographical Society.



Facsimile of Central Part of the Same District, enlarged to the scale of 1 : 175,000, from Sheet Nº 45 (S.W.) of the Indian Atlas.

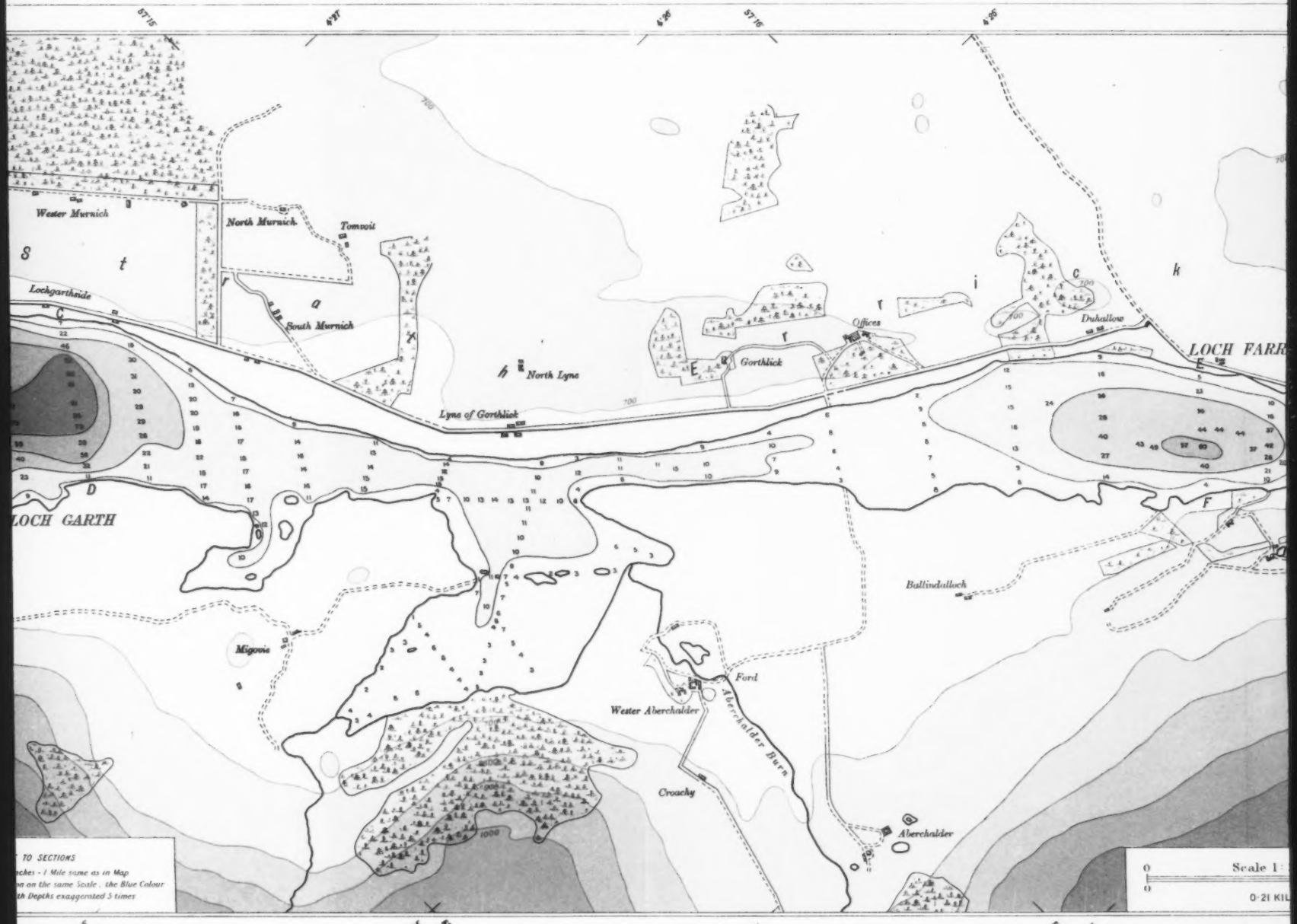
PLATE XIV


LOCH MHOR
(LOCHS GARTH & FARRALINE)
(NESS BASIN)
SURVEYED IN 1903 BY
T. N. JOHNSTON, M.B., C.M., R. C. MARSHALL, M.A.
R. B. YOUNG, B.Sc., AND JAMES MURRAY.
Height of Surface of Water above Sea Level, 638·5 feet
The Land Contours are from the Ordnance Survey
Wester Murnich
Bailebeag
Church
Newton
Lochgartheide
River Gourag
Bunkegivie
Corriegarth Lo.
LOCH GARTH
Garthbeg
River E.
CROSS SECTION
CROSS SECTION
NOTE TO SECTIONS

Bathymetrical Survey of the Fresh-water Lochs of Scotland

UNDER THE DIRECTION OF

Sir JOHN MURRAY, K.C.B., F.R.S., D.Sc., and LAURENCE PULLAR, F.R.S.E.



LONGITUDINAL SECTION ALONG AXIS OF MAXIMUM DEPTH

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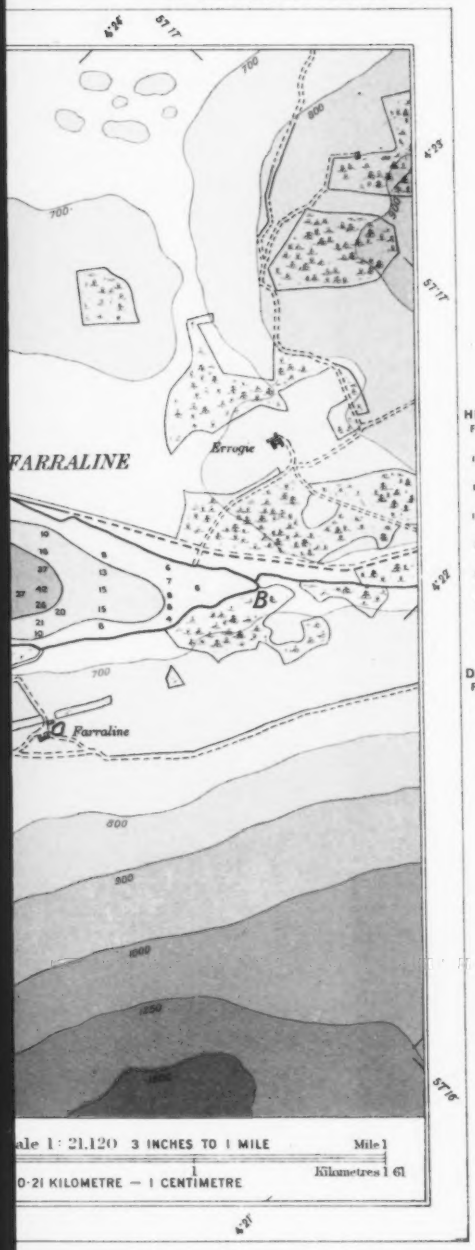
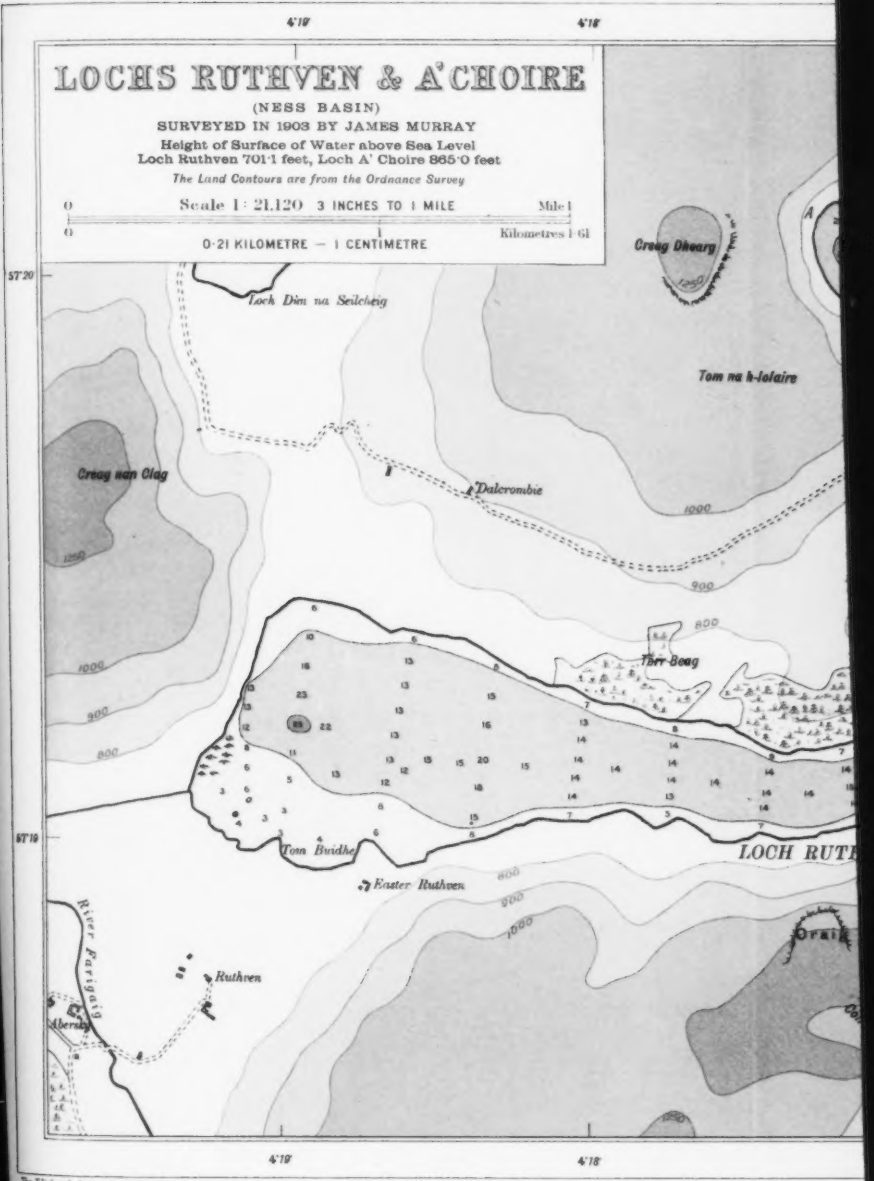


J. G. Bartholomew

BATHYMETRICAL SURVEY OF THE FRESH-WATE

UNDER THE DIRECTION OF

SIR JOHN MURRAY, K.C.B., F.R.S., D.Sc., AND LAUREN



The Edinburgh Geographical Institute

NOTE TO SECTION

Scale of Length 3 inches = 1 Mile same as in Map
The Black Part is the Section on the same Scale, the Blue Colour shows the Section with Depths exaggerated 5 times

A

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SH-WATER LOCHS OF SCOTLAND

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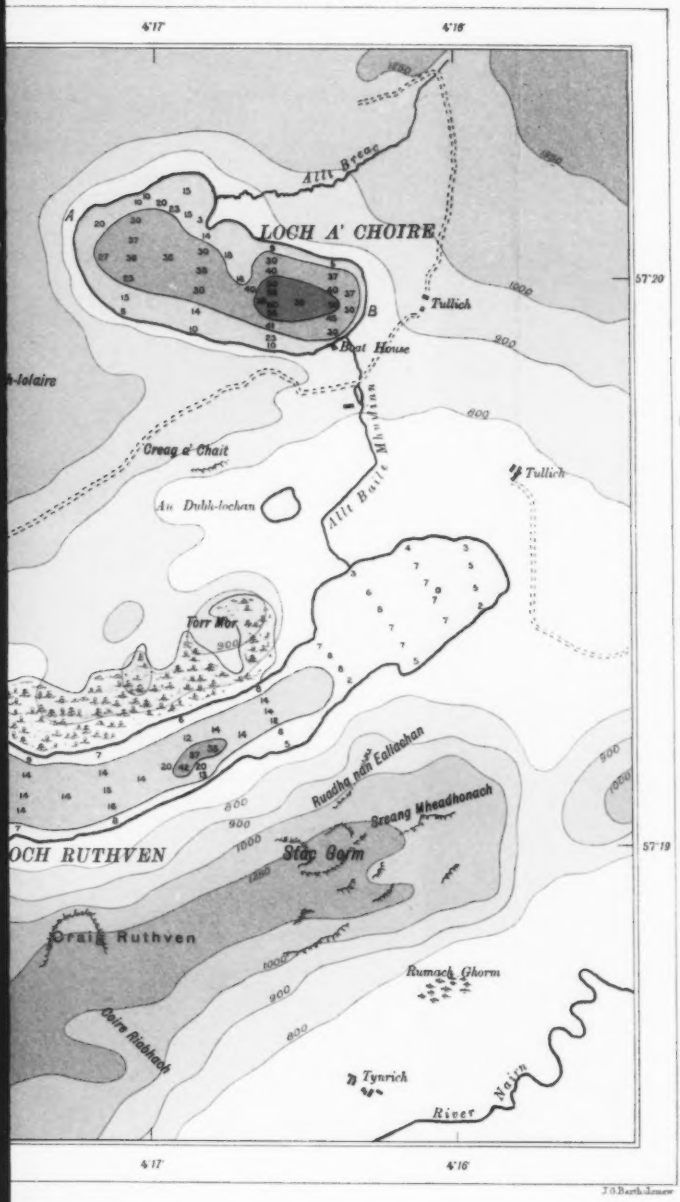
ND LAURENCE PULLAR, F.R.S.E.



HEIGHTS IN FEET

FEET	METRES
1250	381·1
1000	304·8
900	274·3
800	243·8

DEPTHS IN FEET

FEET	METRES
10	3·05
25	7·6
50	15·2

J.G. Bartholomew

SECTION